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Research on Food Preservation in the U.K.

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Research on food

DEPARTMENT OF SCIENTIFIC & INDUSTRIAL RESEARCH

RESEARCH ON FOOD PRESERVATION IN THE UNITED KINGDOM

LONDON: HER MAJESTY'S STATIONERY OFFICE
1954

FOREWORD

In response to a demand for information with regard to the official and semi-official organizations in the United Kingdom which undertake research on food, short articles have been published recently in *Food Science Abstracts*, detailing the work in progress in various establishments, the facilities available and the staff engaged. These notes have been revised and brought up to date and are now published as a reference book.

The field of research covered is that of the processing, storage and transport of food. Work on food production and on nutrition is only included in so far as it forms part of the programme of organizations which are also concerned with food preservation.

For information with regard to research in progress at the Universities, reference may be made to "Scientific Research in British Universities, 1951-1952"*.

FRANKLIN KIDD,
Director of Food Investigation.

Food Investigation Organization,
20A Regent Street,
Cambridge.

January, 1954.

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RESEARCH ON FOOD PRESERVATION IN THE UNITED KINGDOM

THE FOOD INVESTIGATION ORGANIZATION OF THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Introduction

THE Food Investigation Organization was established in 1917 and is one of the fourteen research Organizations of the Department of Scientific and Industrial Research—a Department responsible to the Lord President of the Council. The Organization is charged with research, for the benefit of the community as a whole and to meet the requirements of Government Departments, in the field between primary production of food on the one hand and ultimate consumption on the other. The properties and behaviour of food-stuffs and the engineering problems concerned with their handling are included in its terms of reference. The practical aims of its research activities are to improve the quality of food-stuffs and reduce the cost to the consumer by minimizing wastage and by improving the practices of storage, transport and processing. The Food Investigation Organization does not itself cover the whole range, but maintains close collaboration with the other research stations in the United Kingdom described in this publication.

The Director of Food Investigation is advised by a scientific Board, the members of which serve in their personal capacities. United Kingdom Government Departments and countries of the Commonwealth interested in the work of the Organization nominate Assessors to the Board. There are now 21 assessors from 11 departments and 7 Commonwealth countries. The present Chairman is Professor Sir Frank L. Engledow, C.M.G., M.A., F.R.S., Drapers' Professor of Agriculture in the University of Cambridge.

There are in the Organization three main laboratories and three sub-stations. The Headquarters of the Organization is housed separately.

At the request of approved Organizations and Universities, the Food Investigation Organization provides working space and facilities at its research stations for a limited number of voluntary workers and students working for research degrees.

HEADQUARTERS

20a Regent Street, Cambridge

Director of Food Investigation:
Franklin Kidd, C.B.E., M.A., D.Sc., F.R.S.

Experimental Officer Class: 6
Other Grades: 8

The functions of the Headquarters are : to give general scientific direction to the work in progress ; to maintain contact with other food organizations ; to co-ordinate the advisory services and to answer enquiries ; and to prepare *Food Science Abstracts.*

LOW TEMPERATURE STATION FOR RESEARCH IN BIOCHEMISTRY AND BIOPHYSICS

Downing Street, Cambridge

Superintendent:
E. C. Bate-Smith, M.Sc., Ph.D.

Senior Principal Scientific Officers:
E. H. Callow, B.Sc., Ph.D., F.R.I.C.
M. Ingram, M.A., Ph.D.
C. H. Lea, B.Sc., Ph.D., D.Sc., F.R.I.C.

Principal Scientific Officers:
J. R. Bendall, B.A.
J. Brooks, O.B.E., B.Sc., Ph.D.
J. M. Bryan, B.Sc., Ph.D.
P. R. P. Claridge, T.D., M.A.
R. Gane, M.A., M.Sc., Ph.D., A.R.I.C.
F. A. Isherwood, M.A., B.Sc., Ph.D.
L. W. Mapson, B.A., Ph.D.
S. M. Partridge, M.A., B.Sc., Ph.D., F.R.I.C.
J. G. Sharp, M.A., B.Sc., Ph.D.
H. G. Wager, B.Sc., M.A., Ph.D.

Senior Scientific Officers: 6

Scientific Officers: 1

Experimental Officer Class: 21

Other Grades: 46

Buildings and Equipment

The Low Temperature Research Station is the largest in the Organization. It was opened in 1922, and was the first laboratory to be fully equipped with refrigeration for the study of biological processes. The Station has a series of 40 constant temperature rooms, which are maintained at temperatures within the range − 30° to +35°C. (*− 22° to +95°F.*), with an accuracy of 0·1°C. (*0·2°F.*), and which are sufficiently large to be used as laboratories. The building includes space and equipment for the study of processing methods on a laboratory scale.

The Committee of Management is a University Committee as well as a Departmental Committee and consists of nominees of both the University and the Department.

General Scope of the Work

The main work is basic, long-range research into the biochemistry and biophysics of food-stuffs and their constituents. There are sections devoted to work on proteins, carbohydrates, and fats ; plant and animal biochemistry and physiology ; and the metabolism of micro-organisms. Other sections deal with electronic sterilization, the corrosion of metals, and the physical properties of materials.

On the applied side, work on meat and eggs and on aspects of curing, freezing, drying, and canning is carried out.

Basic Researches in Progress

Physiology and Biochemistry of Muscle. The work is centred around *rigor mortis* and the factors which affect the retention of fluid in the muscles and the texture of the meat after freezing, storage, and thawing.

Connective Tissue. Connective tissue is an important constituent affecting the quality of meat. The chemical structure and function of the connective tissue proteins, and of the mucoids and muco-polysaccharides which occur with them, are being studied by modern methods, including chromatography. New chromatographic and ion exchange techniques for the analysis and

isolation of sugars, amino acids, and organic bases have been developed. Stepwise degradation of certain of the large molecules concerned has been achieved. These methods are being applied to the investigation of cell-wall components and the organic acids of plant tissues, and to the survey of the minor constituents of plant and animal tissue extracts.

Ascorbic Acid and Enzymic Browning. The mechanism of the synthesis of ascorbic acid in plants, and its role in the respiratory mechanism of the cells, are being investigated. It has been shown that ascorbic acid and glutathione form part of a system which may be of major importance in the respiration of the plant, and in the browning of tissues which occurs after injury.

Synthesis of Protein. Studies on the synthesis of peptide bonds have drawn attention to the important possibility that transpeptidization reactions may be concerned in the synthesis of proteins.

Synthesis of Polysaccharide. One aspect of the continuing study of the biological systems of plants is the investigation of the enzymic reactions. An outcome of an investigation of the potato enzyme systems concerned with polysaccharide synthesis has been the first *in vitro* synthesis of starch.

Tannins and Anthocyanins. These and other polyphenolic constituents of plant tissues, and in particular of the cacao bean, are being studied, and extraction procedures worked out. The behaviour of these compounds on various types of chromatographic column have been examined, with a view to their separation, identification, and determination.

Spoilage Reactions in Dried Foods. Apart from the action of micro-organisms, two of the major causes of spoilage in foods are oxidative rancidity, due to the reaction of the fatty constituents with atmospheric oxygen, and the so-called 'browning reaction', arising mainly from the interaction between amino acids or proteins and reducing sugars. Work on the mechanisms of these complex processes is being carried out both directly with individual foods and, more particularly, with chemically simplified 'model' systems of pure fatty esters, lipids, proteins, and sugars.

Microbiology. Work on microbiology tends to be rather diverse, because of the variety of problems arising in connection with foods. Lately the greatest emphasis has been on the bacteriology of meat, especially whale meat, and the interesting fact has emerged that the development of putrefying bacteria cannot begin until after *rigor mortis*. There is naturally much interest in ways of preventing the development of micro-organisms in foods, and some of the newer methods—e.g. high-frequency radio waves and beams of electrons—are at present being examined. Work on the fermentation of fruit juices has also raised problems regarding the mode of action of the sulphur dioxide commonly used to preserve such juices. Among the physiological problems, the mechanism by which bacteria reduce ascorbic acid is being studied, in the hope that it may show useful analogies with the corresponding systems in plant cells. The means whereby micro-organisms are able to endure extreme concentrations of sugar or of salt have been examined.

Applied Studies in Progress

Meat. In collaboration with the School of Agriculture, Cambridge, there is a continuing programme of investigation into the factors in animal husbandry which affect the composition and quality of carcase meat. In collaboration

with other interested bodies, a study is being made of the factors which affect the quality of frozen beef.

Bacon. The optimal conditions for the smoking of bacon are being studied. New types of smoke stack, which resemble the kiln developed at the Torry Research Station, are being investigated, and their performance in relation to the traditional methods of smoking are being evaluated.

Eggs. Egg production in Europe has now begun to approach its pre-war volume. This recovery has been accompanied by a renewed interest in long-term storage, both in this country and in countries which export eggs to the United Kingdom. The seasonal nature of egg production has led to a search for satisfactory methods of storage. In collaboration with the Ministry of Food, investigations are carried out on different methods of storing eggs in shell. This work is then followed by full-scale trials. Research has also been done on methods of processing eggs, such as the drying or freezing of whole egg, white, or yolk. Work is now in progress to improve these methods.

Physics and Engineering. The corrodability of aluminium has always limited its application in the food industry. A recent result of work on the corrosion of aluminium has been a new method of direct plating with nickel and copper.

The collection of data on heat and water transfer, which are essential to a proper design of food processing methods and machinery, has been a long-term commitment. A study has been made of the water relations of many types of dried food ; this formed part of the work in progress on the physical properties of dried foods.

The application of modern chromatographic methods to the commercial production of certain constituents of foods is being studied.

SMITHFIELD LABORATORY

91 Charterhouse Street, London, E.C.1

Officer-in-Charge:
E. H. Callow, B.Sc., Ph.D., F.R.I.C.

The Smithfield Laboratory, a sub-station of the Low Temperature Research Station, was opened in 1938 to keep in touch with the day-to-day problems of the meat industry and to help in their solution.

TORRY RESEARCH STATION

11 Baxter Street, Aberdeen

Superintendent:
G. A. Reay, O.B.E., M.A., B.Sc., Ph.D., F.R.I.C.

Senior Principal Scientific Officer:
J. A. Lovern, B.Sc., Ph.D., D.Sc., F.R.I.C.

Principal Scientific Officers:
A. Banks, B.Sc., Ph.D., F.R.I.C.
C. L. Cutting, B.Sc., Ph.D., F.R.I.C.
J. M. Shewan, B.Sc., Ph.D., A.R.I.C.

Senior Scientific Officers: 5

Scientific Officers: 4

Experimental Officer Class: 21

Other Grades: 58

General Scope of the Work

This Station was opened in 1929. It is concerned with the preservation of fish as food, from the time it is taken from the sea until it is consumed, and with the utilization of surplus fish and fish waste. The research work includes both immediate practical developments and basic long-range investigations.

Buildings and Equipment

In addition to chemical, physical, and bacteriological laboratories, there is space for fish-working and for the testing and operation of prototype, pilot scale, and occasionally larger plants for various types of processing. Permanent facilities exist for the freezing of fish and for cold storage at closely controlled temperatures within the range +5° to −30°C. (*41° to −22° F.*). A building entirely devoted to work on freezing and cold storage is now (1953) being erected ; this will contain engineering and biochemical laboratories, refrigeration plant, fish-working space, and considerably extended cold storage facilities. The low temperature storage rooms will have several novel features, including jacket cooling. There are engineering and wood-working shops for the construction of apparatus, ranging from that required in the laboratories to small scale processing plant.

The Station has its own motor fishing vessel, equipped for trawl and line fishing and with a small laboratory for scientific and technical investigations at sea. A new research trawler, about 130 feet b.p. in length, has been designed for a wider range of work. The fish hold will be comparable in size to holds on commercial vessels, and the ship will also be capable of carrying pilot scale processing plant such as freezers. This vessel will be the first British diesel-electric trawler ; it will be powered by a number of small high-speed engines which will be serviced by replacement.

Basic Researches in Progress

Bacteriology. Work includes qualitative and quantitative studies of the microflora of fresh and deteriorating fish in relation to such factors as species, season, marine environment, and mode of fishing ; studies of the biochemical activities of marine micro-organisms, with a view to establishing a clearer taxonomy and a better understanding of their function in spoilage ; and studies on the effect of physical and chemical conditions in various methods of processing (e.g. smoking, salting, freezing, and drying) upon the microflora and its activities. Certain specialized groups of the microflora, such as the halophiles and chitinivorous and agar-decomposing bacteria, are also being investigated.

Fats. The fatty acid composition of the fats from numerous species of fish has been examined in detail. Differences observed have been traced to the operation of such factors as food, season, and genetic relationships.

Studies on the oxidation of fish fat have shown that atmospheric oxidation is catalysed by haematin-protein compounds, present in the lateral band of red muscle which forms part of the fat depot in fatty fish like the herring. Investigations are in progress on the autoxidation of unsaturated fatty acids and their derivatives, in order to elucidate the complex reactions which occur during catalytic oxidation. Applied and fundamental work on anti-oxidants is also being carried out.

Lipoprotein Complexes. The object of this work is to gain knowledge of the

chemistry of the complex mixture of lipids present in the cells of non-adipose tissue (e.g. the flesh of white fish), to determine to what extent and with what types of linkage these lipids are bound to protein, and to discover the properties, chemical and physical, of isolated lipoprotein complexes. Methods are being developed for the separation of the lipid mixture into its component classes and for quantitative determination of these classes.

Proteins. The separation and characterization of the proteins of fish muscle are being studied by the newer physico-chemical techniques. The aim is to link this work with the study of lipoprotein complexes and the effect upon the properties of these complexes of various commercial processes.

Extractives of Muscle. The extractives of fish muscle consist, amongst other things, of carbohydrates and their metabolic products, and of nitrogenous substances such as trimethylamine oxide, urea, carnosine, anserine, and amino acids. A qualitative survey of several species of both marine and freshwater fish, using ion exchange resins and paper chromatography, has shown that the composition of this fraction of the flesh may vary with family, species, environment, and possibly season. Some of these extractives are amongst the first constituents of the muscle to be subjected to bacterial attack ; they are almost certainly involved in the changes in flavour, odour, and other characteristics which occur during spoilage and in certain types of processed fish. Methods for the quantitative determination of these extractives are being examined.

Chemistry of Wood Smoke. Methods are being developed for analysing, both qualitatively and quantitatively, the constituents of the wood smoke used for curing fish. There is evidence that the phenolic constituents particularly are important in the biological stability, colour, flavour, and odour of smoke-cured fish.

The Physics of Smoking and Drying. A study has begun of the physical properties of wood smoke. A better understanding of the smoking process should make it possible to specify the optimum conditions. More accurate methods of measuring humidity and water content are also being investigated. A novel capacitance-resistance hygrometer may make it possible to study more closely than heretofore the movements of water in tissues during the drying process. The investigation of these and other problems is the concern of the new Physics Section.

Applied Studies in Progress

The Handling and Stowage of Fresh Fish. In 1928, a survey of practice and full-scale experiments were made on board trawlers fishing the ' near ' and ' middle ' waters. Further survey and experiment on vessels fishing the ' distant ' waters, mainly in the Arctic, have yielded data concerning the relative importance of many of the factors concerned in the treatment of the fish ; practical recommendations for improving the quality of fish chilled with ice have been given to the trade.

Chilling is the factor of over-riding importance in the preservation of fish. Prompt chilling and better deployment and preservation of the ice in stowage help to retain quality. Proper gutting and washing, and the avoidance of crushing in stowage by the more liberal use of shelving, are important contributory factors.

A test panel has been trained to assess quality organoleptically according to a scoring system ; the scores allotted are compared with the results of objective

chemical and bacteriological tests. Efforts are being made to improve the accuracy of the sensory assessment. The possibilities of using chemical tests to evaluate quality are being examined.

The effects of such factors as environment, season, and sexual maturity, as well as the effect of hygiene, both on board ship and on shore, on the rate of spoilage are being investigated.

Laboratory and pilot scale experiments have shown that by stowing iced fish in an atmosphere of carbon dioxide (30 to 40 per cent), the period of edibility can be extended by at least 7 to 10 days.

The preservation of fresh herring, mainly caught on overnight voyages, has been studied under conditions of commercial fishing. The experiments showed that quality would be much improved if chilling in ice, not now the normal procedure, and stowage in boxes were adopted.

The same principles apply equally to transport of fresh fish on land. From time to time, in collaboration with other bodies, experiments on the land transport of fish have been carried out.

Freezing and Cold Storage. Present investigations include studies on the physical and biochemical changes which occur during the freezing and cold storage of fish. The possibility of using certain characteristics of frozen fish as a basis for estimating acceptability is also being investigated. In addition, further work on the freezing and cold storage of herring and kippers is in progress, including the examination of proposed new products.

Since, on long voyages, ice alone cannot preserve the entire catch, the possibilities of freezing at sea are being explored. Research is now being actively directed towards the development of methods and equipment suitable for this purpose. Particular attention is being given to economy in space and labour and to workability in conditions such as exist in the ' distant ' water fisheries.

At the same time research is planned to find cheaper methods of freezing herring on shore. A satisfactory method has been devised for the freezing and cold storage of lobsters ; work on the freezing and cold storage of crabs is proceeding.

Salt-Curing. An empirical study has been made of the physical interaction between the flesh of herring and dry salt or salt solutions, particularly with a view to assessing the possibilities of producing more lightly salted cures. Trials made in conjunction with the Herring Industry Board have shown that the traditional skilled hand gutting, packing, and salting in wooden barrels can be replaced, without loss of quality, by mechanized gutting, vatting with brine in bulk in non-wooden tanks, and final packing in consumer size containers of lacquered tinplate. It is believed that the market for salt herrings might be extended if new and more attractive packs of carefully graded cures, in sizes acceptable to different types of consumer, were made available.

The browning of the split surface of salted white fish such as cod and ling in the wet stack, with subsequent loss in market value, is being studied with a view to its prevention, or amelioration. Pure salts increase the incidence and degree of browning, and interest is being focused on the constituents in the less pure fishery salts which can prevent colour development.

Smoke-Curing. The conditions necessary for the production of a palatable, well-cured, cold-smoked product of good appearance and keeping quality have been established.

The traditional vertical smoke-curing kiln involves much labour in loading and discharging the fish and in shifting them during curing, in order to try to obtain a uniform product under extremely variable, uncontrollable conditions. A batch, horizontal flow, controlled smoke-curing kiln has been developed in which the optimum conditions for smoke-curing can be maintained; the temperature, humidity, rate of air flow, and density of the smoke can be controlled, and kept uniform throughout the kiln independently of atmospheric conditions. Work is proceeding on the development of a direct reading smoke density meter which will make operation of these kilns more certain. A number of firms are operating kilns of this type.

Drying. During the war, methods of dehydrating and storing minced 'white' fish and herring were worked out at the Torry Research Station. The process was developed to the factory scale. Exploratory work is continuing on improved methods of drying fish, including vacuum drying. Special types of cure, in which drying may be combined with salting and smoking, are being investigated on a very limited scale. The object is to develop inexpensive cures suitable for export to those tropical countries where there is a shortage of animal protein in the diet. The storage problems must also be considered.

By-Products. Until recently, the recovery and properties of fish oils have been studied mainly. The amounts of vitamin A in oils from the liver, intestine, and flesh of different species, and in particular the liver and gut of halibut, have been determined.

In this country an oil and meal industry utilizing herring surplus to direct food outlets has been developed; but much experimental work has been and still is necessary in evaluating known processes in relation to British conditions and in working out new processes. Such work has been in progress for some years at the Torry Research Station. Research on the production of white fish meal is also being carried out in close collaboration with the industry.

Present work includes the study of an alkali digestion process for the production from herring of high quality oil in very high yield. The recovery of protein, without damage to its nutritional value, is an additional aim. This process has the special advantage that herring can be stored satisfactorily in times of glut without causing offensive odours.

HUMBER LABORATORY

Wassand Street, Hull

Officer-in-Charge:
C. L. Cutting, B.Sc., Ph.D., F.R.I.C.

A sub-station of the Torry Research Station has been established in Hull, to serve as a base for work in connection with the 'distant' water trawling carried out from the Humber ports, and to provide contacts with the English fishing industry. At first, work was carried out temporarily on the premises of the Hull Ice Company. A new laboratory has now been built, and was opened in December, 1952. A part of the research programme on the smoking and drying of fish, formerly carried out at Aberdeen, has been transferred to the new Laboratory. Various other problems, both of immediate and indirect interest to the fishing industry, are also being investigated.

DITTON LABORATORY

East Malling, Maidstone, Kent

Superintendent:
R. G. Tomkins, M.A., Ph.D.

Principal Scientific Officers:
W. G. Burton, M.A., B.Sc.
J. C. Fidler, B.Sc., Ph.D., M.Inst.R.
A. C. Hulme, M.Sc., Ph.D., A.R.I.C.
W. H. Smith, B.A., Dip.Hort.

Senior Scientific Officers: 1
Scientific Officers: 1
Experimental Officer Class: 14
Other Grades: 22

General Scope of the Work

The Ditton Laboratory was built in 1929 with funds provided by the Empire Marketing Board, and was opened in 1930. It was sited near the East Malling Research Station, so that its work could be linked with work on the growing of fruits. Its immediate purpose was to permit experiments on the gas storage of fruit to be carried out on a larger scale than was possible at the Low Temperature Research Station, Cambridge, and to provide special facilities whereby methods of ventilating and of maintaining uniform conditions of temperature in ships' holds and other refrigerated spaces could be investigated experimentally. Its main purpose continues to be the investigation of the transport and storage, and some aspects of the processing, of fruits and vegetables.

The gas storage of fruit, i.e. storage at cool temperatures under restricted ventilation, was worked out, in principle, at Cambridge by Kidd and West between 1918 and 1929 : its application to large-scale practice was worked out at Ditton between 1929 and 1939. Gas storage is particularly suited to the main English culinary and dessert varieties of apple, and the first commercial refrigerated gas stores were built in 1929 ; these stores are now common throughout the fruit-growing areas of Kent, Sussex, Essex, Cambridgeshire, and Northern Ireland. The practice of gas storage has spread from England to South Africa, Australia, the Netherlands, Denmark, France, and Belgium, and is being studied in the United States and Canada.

Buildings and Equipment

A feature of the building is the ' experimental hold ', which is similar in design and construction to a ship's hold, and is fitted with several distinct systems of refrigeration and surrounded by a guard space, the temperature of which can also be controlled. The work for which this unique structure was designed and constructed was carried out in 1930-1937 ; it was found that the most rapid method of cooling stacks of fruit, and of achieving uniformity of temperature within them, was by circulating large volumes of air, preferably vertically, through the stacks. Most modern refrigerated ships incorporate a system of cooling based on the results of these experiments. The hold is now being used as a large cold store, and there are plans for converting it into experimental cold chambers and laboratories.

The centre of the building is occupied by a large factory floor space used for grading and packing fruit, assembling apparatus, and for housing drying plant and other processing equipment. Beyond this are laboratories and constant temperature rooms. There are 13 such rooms, each big enough to

hold, if required, 10 tons of fruit. For gas storage tests on a moderate scale, special cabinets, which hold $\frac{1}{4}$, $\frac{1}{2}$ or 1 ton of fruit, have been designed. These cabinets can be housed in the storage rooms. Facilities are also available for frozen storage.

Besides the main building, there are annexes which are used as offices, store rooms, and extra laboratories. There is an experimental potato warehouse and a 30-ton experimental refrigerated gas store.

To enable experiments on the cold storage and pre-cooling of fruits and vegetables to be carried out in districts where cold storage facilities are not at present available, the Laboratory has designed and had built a mobile experimental cold store. This store has a capacity of approximately 600 cubic feet ; it can be towed to any part of the country, and can be used for small scale or pilot scale tests.

Basic Researches in Progress

Plant Biochemistry. Systematic work on the chemical composition of apples and other fruits has been carried out for some time. An intensive study has been made of the protein and the amino acid constituents of the apple and their relation to the changes which take place during ripening. Work is now in progress on the separation and identification of the volatile compounds produced by fruits. Attention is also being given to the identity and the estimation of the acids present in fruit.

Plant Physiology. A long-range study has been undertaken on the growth and physiology of fruits. This involves observations each year on the development, chemical composition, histology, respiration, and storage behaviour of different varieties of fruits. Progress is being made in finding the relation between chemical composition and physiological activity, and the storage life of apples for which it may be possible to forecast storage properties. More specific problems of plant physiology which are being investigated include the loss of acids during the ripening of fruit and their role in the respiration cycle ; the action of carbon dioxide in depressing respiration and in prolonging storage life, and also in bringing about physiological disorders such as brownheart ; the mechanism whereby exposure to ethylene induces the rise in respiration, known as the ' climacteric ', and whereby ethylene itself is produced by the fruit at this stage of ripening ; and the factors which determine the dormancy of sprouting of potatoes.

Applied Studies in Progress

The Construction and the Control of Conditions in Cold Stores and Refrigerated Gas Stores for Fruit. Data about the design, construction, and performance of cold stores and gas stores are being obtained from surveys of the structure and performance of existing stores, and experiments are being carried out to test the efficiency of new methods, more particularly of certain new types of bituminous preparations, for rendering stores gas-proof. The factors which determine the relative humidity of cold stores and the transfer of water to the cooler surface have been analysed, and experiments are in progress on the transfer of heat to coolers of various designs. Methods of removing certain volatile substances in gas stores by the use of charcoal filters or the addition of ozone, and the effects of doing so on the storage behaviour of fruit, are also being investigated. Information on all these matters will assist the Laboratory

in advising on the design and operation of improved types of cold store and refrigerated gas store.

Storage Trials. Storage trials are being carried out to discover the optimum conditions of storage for varieties of apple, pear, and plum which are of commercial importance. Other trials are being made to find varieties of dessert apple of potential commercial importance which can be stored until late in the storage season, i.e. April or May. Comprehensive storage trials are in progress to determine conditions which will allow vegetables to be stored for the longest possible periods. The effects on vegetables of washing, of icing, and of packaging before storage are also being investigated.

Effect of Pre-storage Treatment. The effects on storage life of certain pre-storage treatments are being studied. These include the effect of treatment with ethylene on the extent of injury arising from exposure to low temperatures ; the effect of exposure to high concentrations of carbon dioxide for short periods on subsequent ripening ; the effect of treatment with oil emulsions and of certain soluble compounds on the rate of ripening, the amount of water loss, and the storage life of apples.

Bulk Storage of Potatoes. The effects of height of stacking, of the extent of ventilation, and of the nature of the bin walls on the distribution of temperatures in stacks of potatoes stored in unrefrigerated buildings are being determined, with the object of assessing the advantages of storage in sheds compared with storage in the more traditional manner in clamps.

Surveys of Wastage. In co-operation with the Ministry of Agriculture and Fisheries, the Ministry of Food, and the National Agricultural Advisory Service, surveys of wastage and deterioration in lettuces, strawberries, plums, and Cornish broccoli have been started. The aim of these surveys is to discover the nature and extent of deterioration during marketing, and to work out methods of reducing and delaying deterioration under normal commercial conditions. A survey is also being conducted, with the help of the National Institute of Agricultural Engineering, to explore existing methods of washing vegetables and to study their effects upon the produce.

Mycology and Bacteriology. Observations are made on the susceptibility of stored fruits and vegetables to rotting, with a view to defining the factors which determine the extent of infection and susceptibility to attack. The systematics and physiology of fruit- and vegetable-rotting organisms are being studied. Special methods such as washing with fungicidal solutions, wrapping in paper impregnated with slightly volatile products, or exposure to gaseous inhibitors, to decrease the amount of rotting, are being investigated.

Advisory Work

The Laboratory keeps in close touch with the horticultural industry, and advises growers on the conditions necessary for storage. Enquiries number some 300 per year and, in most instances, are dealt with by telephone or letter. Where necessary, visits and special surveys of conditions are made.

COVENT GARDEN LABORATORY

Inveresk House, 346 Strand, London, W.C.2

Officer-in-Charge:
J. C. Fidler, B.Sc., Ph.D.

In order to keep in close touch with, and investigate, problems of the marketing and distribution of fruits and vegetables, both imported and home-grown, a small laboratory has been maintained near the Covent Garden Market since 1925.

It is equipped with constant temperature stores, chemical and mycological laboratories, fruit examination rooms, and photographic facilities. The work consists of collecting and examining samples of material passing through the market, and of carrying out experiments on the handling of a wide range of home-grown produce.

It is also the laboratory from which observations are made on the quality of fruit imported from overseas and to which experimental consignments of fruits from overseas are sent for examination. Thus, by arrangements with the Departments of Agriculture in Palestine, Canada, Trinidad, Australia, and New Zealand, consignments of fruit treated in different ways in the country of origin, or stowed under different conditions during shipment to the United Kingdom, have been examined.

The information gained from these experimental shipments has undoubtedly served to decrease the amount of wastage in imported fruit, by bringing directly to the notice of exporters, shippers, and importers the liability of certain cargoes to definite types of wastage, and the extent to which this wastage may vary with initial treatment and conditions during shipment.

THE BRITISH FOOD MANUFACTURING INDUSTRIES RESEARCH ASSOCIATION

Leatherhead, Surrey

Director of Research:
F. H. Banfield, M.Sc., Ph.D., F.R.I.C

Superintendent of Research:
C. L. Hinton, F.R.I.C.

Secretary: L. A. Harvey

Research Staff: 65 (including 31 graduates)

General

The British Food Manufacturing Industries Research Association was formed in 1947 by the amalgamation of two much older research organizations. These were the British Association of Research for the Cocoa, Chocolate, Sugar Confectionery and Jam Trades, formed in 1919 as a result of the co-operation of manufacturers in these three fields, and the British Food Manufacturers' Research Association, formed in 1925 by another group of food manufacturers mainly concerned with meat and fish products. Both functioned at the same address in Holloway, under the same Director of Research, and worked closely together while retaining their separate entities. In 1946, the two Research Associations decided to amalgamate and to build new laboratory

premises at Leatherhead. The new laboratories were completed during 1950, and the British Food Manufacturing Industries Research Association moved to Leatherhead that year.

At the first General Meeting of the new Association in March, 1947, Sir Frank Engledow, C.M.G., M.A., F.R.S., Drapers' Professor of Agriculture in the University of Cambridge, was elected President, and he still holds that office.

The work of the Association is sustained by the subscriptions received from industry, each member firm paying a sum based on the number of its employees engaged in direct production. The income from members is augmented by a Government grant, which is itself dependent on the amount subscribed by industry. There are, in addition, a number of Associate Members, whose subscriptions also rank for Government grant.

The Association is governed by a Council of some 35 elected members, representing all branches of the industry, and 4 members appointed by the Department of Scientific and Industrial Research.

Close contact is maintained with the D.S.I.R., whose work on food-stuffs is generally of a fundamental nature. The Association provides the link between that body and industry, and is more closely concerned with the application of basic research to production problems.

Buildings and Equipment

The new building at Leatherhead comprises nearly 19,000 square feet, and there are some 2½ acres of land available for extensions in the future.

In addition to extensive laboratories for general research with modern equipment, special laboratories are devoted to bacteriological, entomological, and analytical work. There is a series of refrigerated and constant temperature rooms. A large technical laboratory is fitted up with machinery for the study of a number of manufacturing operations on a pilot plant scale.

The Scope of Research

The range of manufactured foods with which the Research Association is concerned is a very wide one, and for that reason the work is divided into a number of broad sections ; the work in each section is guided by a Research Panel consisting of scientists or technologists appointed by member firms. Much of the work undertaken, e.g. the study of the keeping quality of fats, is of interest to more than one section. At present seven permanent Research Panels are dealing with : Bakers' Prepared Materials ; Cocoa and Chocolate ; Jams and Jellies ; Meat and Fish Products ; Pickles and Sauces ; Sugar Confectionery ; and Miscellaneous Products. Special panels are appointed as occasion demands ; a special Panel has for some time been considering the Metallic Contamination of Food-stuffs, and one of its aims is to work out methods of analysis suitable for control purposes in the factory.

Research Reports issued to Members

The results of research are regularly issued to firms who are members of the Association. The subjects of the following reports indicate the scope of the work and the way in which fundamental investigations are blended with the solution of more immediately technical problems : the Determination of Linoleic Acid in Edible Fats ; the Estimation of Vitamin A in Food-stuffs ; the Thermal Efficiency of Gas-Fired Sugar Boiling Stoves ; Thermophilic

Micro-organisms in Raw Products and their Heat Resistance ; the Preservation of Vegetables for Pickling ; the Recovery of Oxidized Essential Oils ; the Composition of Concentrated Tomato Purée ; Some Improvements in Boiling and Cooling Jams ; the Anthocyanin and Tannin Content of Cocoa ; Corrosion of Metal Equipment by Pickles and Sauces ; Analytical Methods for Cocoa, Chocolate and Sugar Confectionery ; the Prevention of Scum Formation on Pickle Cucumbers and Green Olives ; the Stoving of Confectionery ; the Oxidative Rancidity of Edible Fats ; the Composition of Commercial Lecithins ; the Deterioration of the Fresh Appearance of Pork Sausages ; the Shrinkage of Meat Paste in Jars ; the Viscosity of Chocolate ; the Efficiency of Vertical Retorts ; the Solubility of Sugars ; the Determination of the Air Content of Margarine and Compound Cooking Fats ; the Sampling of Nuts, Beans and Similar Articles ; the Composition, Structure and Character of Marzipan ; Changes in the Consistency of Starch Pastes on Cooking ; the Cooking of Hams ; Colour Measurement and its Application to the Recording of the Colour of Foods ; a Simplified Method for the Determination of Nitrite in Curing Brines.

Surveys of the state of knowledge in particular subjects bearing on the processing and preservation of foods are also issued to members. These surveys, in addition to monthly abstracts from current literature, enable members to be fully informed on scientific and technical developments in the industry.

Co-operation with other Research Institutions

The Association keeps in close touch with the basic investigations being carried out by the research stations of the Department of Scientific and Industrial Research ; such investigations include the tannins and anthocyanins of the cocoa bean, the rancidity of fats, the corrosion of metal machinery and utensils, the canning of fish, and the nature of the fruit pectins.

Special arrangements exist to make available to members the results of research on the physical properties of butter, margarine, and compound fats, which is being carried out by the National Institute for Research in Dairying, and on the properties of gelatine, by the British Gelatine and Glue Research Association.

Although the B.F.M.I.R.A. is not concerned directly with the baking industry, there are many points of contact with the work of the British Baking Industries Research Association, e.g. a joint report on the properties of substitutes for albumin was prepared and issued to members of both Research Associations.

The production of cocoa beans throughout the world is of great importance to a substantial number of members of the Association. Dr. Banfield is a member of the Colonial Office Cocoa Research Sub-Committee, and the Research Association is closely concerned with the Cocoa Scientific Advisory Committee, appointed by the Cocoa and Chocolate Industry, which works in liaison with the various research establishments overseas on questions relating to the eradication of disease, the development of new types, and improvements in the methods of preparation of cocoa beans in the countries of origin.

Research in Progress

Since the programme of research covers a very wide field, only some part of it can be given. The investigations in progress are all directed towards one end—the most efficient use of the raw materials available to the manufactured

food-stuffs industry for the preparation of clean, wholesome products, and the preservation of those products from deterioration during storage and distribution.

Cocoa and Chocolate. Work includes an investigation of the natural anti-oxidants present in the cocoa bean, a study of the rheological properties of chocolate, the measurement of particle size, and the determination of the glyceride constituents of cocoa butter and their effect on the stability of the butter.

Sugar Confectionery. The keeping quality of certain types of confectionery is closely linked to moisture content. The determination of small amounts of residual moisture in boiled sweets presents some difficulty and is being investigated. Other work includes studies on the drying of confectionery gums and jellies during manufacture, and on the plastic behaviour of toffee and means for increasing its hardness.

Oils and Fats. The keeping quality of fats is a question affecting many sections of the industry. Research of a basic nature is being carried out on the oxidative rancidity of fats. More specifically, the measurement of occluded air in margarine and compound cooking fats, and its effect on their keeping qualities and vitamin contents, is being investigated.

Meat and Fish Products. A wide field of research includes : the effect of cooking upon the digestibility of meat ; the utilization of whale meat ; the rate of cooling of open meat packs ; the bacteriology of bacon curing brines ; deterioration in the appearance of beef and pork sausages ; and the shrinkage of meat and fish paste in jars. Attention is also being given to the calculation of the times required for processing canned foods, on the basis of the thermal resistance of the spores of micro-organisms responsible for spoilage. In collaboration with the D.S.I.R., the method developed in the United States for the electronic sterilization of canned foods is being closely studied.

Pickles and Sauces. Work is being continued on the brining of vegetable products and the suitability of certain types of vegetable, e.g. red cabbage, for pickling purposes. One of the main investigations is a study of the acid-tolerant micro-organisms which cause spoilage in pickles and sauces. The acid-chloride liquors used in the pickling industry raise problems connected with the corrosion, not only of machinery and plant, but also of the metal caps on the jars in which the final products are stored and sold ; these problems are being studied.

Jams and Jellies. The properties of pectin jellies have been investigated over a number of years, and research on the factors governing the setting of pectin is continuing. A provisional test for the grading of commercial pectins has recently been developed. As and when time permits, data continue to be accumulated on the composition of fruits of different varieties. The new varieties of fruit that are continually coming into the market make this an important item on the research programme, as is the assessment of the value of these new varieties for the manufacture of jam. The breakdown that occurs when strawberries are preserved with sulphurous acid and sulphite solutions is being investigated, since it is a matter of immediate concern to jam manufacturers. The effect of the soluble solids content of jams on their flavour and resistance to mould growth and fermentation is being studied, to determine the minimum content of soluble solids necessary for the production of products having the required keeping qualities.

Sundry Materials. Methods for the recognition and estimation of the various substances present in commercial lecithins are being investigated, with a view to determining the relative importance of these substances in supplying the particular properties of lecithins. Closely allied to this is the means of determining egg solids in products such as salad cream. Other investigations include : a study of the physical properties of starches and their moisture equilibria, in relation to their use in foods ; methods for the assay of commercial sodium pyrophosphate, and certain problems connected with baking powders prepared from it ; the relation between the true soluble solids content of marzipan and the liability of that product to fermentation ; and other questions such as the processing of honey, and the penetration of sugar syrups into citrus peels.

General. The assessment of flavour in various foods receives continuous attention. The application of statistical methods for the interpretation of analytical results is also studied. Of particular interest at present is the accumulation of data on the pectic acid content of cocoa nib and shell, on the basis of a method of determining pectic acid which has recently been adopted by the U.S. Food and Drug Administration. The Association also assists manufacturers in the development of the export trade, by examining samples destined for export, particularly to the United States, for the occurrence of contamination by extraneous matter such as rodent hairs, and for mould filaments in jams which are derived from the fruit from which the jam is made. Members of the Association are kept informed of the provisions of, and changes in, the Food Laws of a large number of countries to which goods are exported. The Association issues advice to members on packages and methods of packing most suitable for particular products, as well as on legal requirements in relation to the labelling of foods.

MINISTRY OF FOOD
SCIENTIFIC ADVISER'S DIVISION

General Functions

The Division is concerned with the application of scientific and technical knowledge to all aspects of the procurement, processing, and distribution of food. It is jointly responsible with the Ministry of Health for advising on nutritional policy through the medium of the Interdepartmental Standing Committee on Medical and Nutritional Problems. On the basis of this policy, it advises on the relation between the nation's nutritional needs and the plans for the importation and home production of food, as well as on the feeding of special groups of the population. It furnishes guidance on nutrition education. It is responsible for co-ordinating investigations into new projects, and, where necessary, initiating research and undertaking development. It maintains liaison between research departments and organizations, scientific and medical committees, and the commodity divisions of the Ministry.

Origin of the Division

The Division was constituted on a permanent basis in 1947. Before this date, the scientific work of the Ministry had been under the direction of Professor J. C. Drummond (the late Sir Jack Drummond, F.R.S.), who was appointed

Scientific Adviser in 1940 ' to give advice and assistance on scientific problems arising in any part of the Ministry '. He was aided by a Deputy Scientific Adviser, Dr. T. Moran, C.B.E., who was also Director of Research. The Division at that time consisted of a small scientific staff and worked mainly by co-ordinating information from research bodies, although the Cereals Research Station at St. Albans had been taken over by the Ministry at the time that its Director became Deputy Scientific Adviser. Sir Jack Drummond and Dr. Moran both resigned at the end of the war, i.e. in 1946. In October, 1947, Dr. Norman Wright was appointed Scientific Adviser, and the Division was reorganized and expanded to take its present shape. This has been planned to conform to the general recommendations of the Advisory Council on Scientific Policy (First Annual Report, 1947-48) regarding the functions of scientific divisions in executive departments.

Organization of the Division

The Division includes the Scientific Adviser's Office and three Sections concerned, respectively, with food technology, nutrition, and food defence. At its sectional headquarters in London, it has chemical and bacteriological laboratories, experimental kitchens, and a taste panel room. It also has a large Experimental Factory (q.v.) at Aberdeen for developmental work.

SCIENTIFIC ADVISER'S OFFICE

Dean Bradley House, Horseferry Road, London, S.W.1

Chief Scientific Adviser:
N. C. Wright, M.A., D.Sc., Ph.D., F.R.I.C.

Experimental Officer Class: 1

The Scientific Adviser represents the Division on the main Standing Committees of the Ministry and has overall responsibility for the activities of the Division.

SECTIONAL HEADQUARTERS

Great Westminster House, Horseferry Road, London, S.W.1

FOOD TECHNOLOGY

Officer-in-Charge:
Vacant (Temporarily: H. R. Barnell, M.A., Ph.D., B.Sc., M.I.Biol.)

Principal Scientific Officers:
N. E. Holmes, B.Elec.E., M.Mech.E.
K. W. B. Jones, B.Sc., Ph.D.
W. K. Melrose, B.Sc.

Senior Scientific Officers: 2
Scientific Officers: 1
Experimental Officer Class: 6
Other Grades: 9

The Section covers a wide field of scientific enquiry and development directed towards promoting improvement in the supply and quality of foodstuffs. Its function may be briefly summarized as the application of scientific

knowledge to the finding of alternative sources of food, to the fuller use of existing supplies, and to the prevention of loss of quality and of waste in storage, transport, and distribution and work in connection with the scientific and technical aspects of the Food and Drugs Regulations.

The work is divided broadly into five main sections:

i. Problems concerned with protein-rich foods, with the application of refrigeration to foods, and with food storage generally.

ii. Problems concerned with carbohydrate-rich foods, mainly cereals.

iii. Problems concerned with oils and fats.

iv. Problems broadly concerned with food composition, with food hygiene, and with Welfare food schemes.

v. Problems concerned with food quality and the prevention of food wastage.

Each Group works in close co-operation with the corresponding administrative or commodity Divisions of the Ministry, with the other Government Departments concerned, and with the relevant research organizations—where desirable through the aegis of Interdepartmental Co-ordinating Committees set up on a commodity basis.

NUTRITION

Officer-in-Charge:
Miss D. F. Hollingsworth, B.Sc., Dpl. Diet., M.I.Biol.

Senior Scientific Officers: 2

Experimental Officer Class: 8

Other Grades: 7

The functions of the Section are, briefly, the application of the science of nutrition to the practical problems of the Ministry. The work is divided into two main sections:

i. Technical nutrition problems, including the requirements of individuals and populations, food composition, and dietary and other specialized surveys; and, in collaboration with the Ministry's Statistics and Intelligence Division, the collection of statistical data of nutritional importance.

ii. Problems connected with experimental cookery, and with the assessment of quality in food-stuffs by the use of taste panels.

The two Groups work in close touch with the Education and Health Departments.

FOOD DEFENCE RESEARCH

Officer-in-Charge:
H. R. Barnell, M.A., Ph.D., B.Sc., M.I.Biol.

Principal Scientific Officers:
E. B. G. Gooding, M.A., M.I.Biol.
J. F. Hearne, F.R.I.C.
S. W. F. Hanson, M.Sc., F.R.I.C.
J. M. Hay, D.Sc., M.I.Mech.E., F.R.S.(E.)
E. J. Rolfe, B.Sc., F.R.I.C.

Senior Scientific Officers: 3
Scientific Officers: 3
Experimental Officer Class: 16
Other Grades: 27

This Section has an office at Headquarters, staffed by two Principal Scientific Officers, Mr. J. F. Hearne and Dr. K. B. W. Jones (loaned by Food Technology Section). There is also an office in Washington occupied by Mr. S. W. F. Hanson. The remainder of the staff of the section are located at the Experimental Factory at Aberdeen. The London office is responsible for maintaining liaison with the relevant administrative Divisions of the Ministry. It also serves as the Scientific Adviser's link with the Service Departments, with the Washington office, and with the Commonwealth.

The purpose of the Washington office is to maintain close touch with scientific and technological developments in North America.

THE EXPERIMENTAL FACTORY, ABERDEEN

The Experimental Factory has a floor space of 30,000 square feet, divided into three bays. It is designed to provide facilities for the development, up to a semi-commercial stage, of promising new processing techniques. The present work is largely concerned with the dehydration of meat, fish, and vegetables. The factory is equipped with both pilot and semi-commercial scale plant, and with control laboratories and facilities for quality assessments of the products.

This note on Scientific Adviser's Division was revised in July 1954

FRUIT AND VEGETABLE CANNING AND QUICK-FREEZING RESEARCH ASSOCIATION

Chipping Campden, Gloucestershire

Director:
F. Hirst, M.Sc., A.R.C.S.

Deputy Director: W. B. Adam, M.A., F.R.I.C.

Senior Scientific Staff:
T. G. Gillespy, B.Sc., Ph.D., A.R.C.S.
D. Dickinson, M.Sc., Ph.D., F.R.I.C., F.R.San.Inst.

Junior Scientific Staff: 1
Assistant Staff: 13
Secretary: E. Sheppey

General Scope of the Work

In 1952, the Fruit and Vegetable Canning and Quick-Freezing Research Association was formed to carry on the work of the University of Bristol Fruit and Vegetable Preservation Research Station, better known as the Campden Research Station. The latter body, which started its activities in 1923, formed part of the Department of Agriculture and Horticulture at Bristol University and played a large part in the development of the British fruit and vegetable canning industry, for which it acted as the research and advisory centre. The new Research Association is governed by a Council consisting of representatives of firms engaged in fruit and vegetable canning or quick-freezing or in allied trades, and of the Department of Scientific and Industrial Research. The building, which is situated on the outskirts of the old Cotswold town of Chipping Campden and within a few miles of the Vale of Evesham, contains chemical, bacteriological, and physical laboratories, a quality inspection room, large experimental rooms, and a library. Some research work of a basic nature is undertaken, but the chief activities are *ad hoc* investigations concerned with the evaluation of processes and the study of specific problems of importance to the canning and quick-freezing industries. In addition to the main lines of research and experimental work, close on 1,000 technical enquiries are answered each year and many visits made to factories.

Basic Researches in Progress

Chemical. Recent work in this field has included the development of paper chromatographic methods for the separation of organic acids, an attempt to isolate from fruit juices specific accelerators and inhibitors of the corrosion of mild steel, and a study of the part played by phytin and pectic substances in firming the texture of green peas.

Bacteriological. The subjects under investigation include a fundamental study of the destruction of bacterial spores by moist heat and of their destruction or inhibition from germination by antibiotics, mathematical solutions to problems of process evaluation, and a survey of species and strains of thermophilic spore-forming bacteria with a view to the collection of data on heat resistance and other characteristics.

Applied Studies in Progress

Suitability of Varieties. New varieties of fruits and vegetables are obtained each season from horticultural institutions and seed merchants and are tested for their suitability for canning and quick-freezing. The varieties are obtained from as many sources as possible, and the more promising are tested for at least four seasons.

Processing of Canned Vegetables. In these tests, all the commoner vegetables have been processed for four periods each at 230°, 240°, 250°, 260°, and 270° F., and the quality (colour, texture, flavour) and nutritive value (carotene, vitamin B_1, ascorbic acid) of the canned product determined.

Evaluation of Raw Peas for Canning. The texture of green peas during ripening is measured by an instrument known as a tenderometer, which records the shearing force required to drag a sample of peas through a standard grid. The results are correlated with physical and chemical characteristics of the peas, field records concerning rate of growth of the crop, and quality of the canned product. The figures obtained are used to form the basis of canner-grower contracts for vined peas.

Texture of Processed Peas. This work is done in conjunction with a series of field trials in progress in the eastern counties. It is an attempt to determine the effect of variety and conditions of growth of harvested peas on the subsequent texture of the canned 'processed' peas.

Stone-gum in Plums. A study of the possible causes of stone-gum in Victoria plums has been in progress for a number of years, the factors at present under investigation being root-stock and fertilizer treatment. There is also work in collaboration with the University of Bristol on the mechanism of gum formation.

Flavour of Canned Pineapples. Work is in progress on the causes of an off-flavour in canned pineapples.

Aluminium Cans. The possibility of using aluminium cans for vegetables and fruits has been studied for several years. The problems are concerned with the type of alloy used, the chemical or lacquer treatment of the surface, the subsequent rate of internal corrosion, and the physical characteristics of the containers. The possibility of toxic substances entering the food from the film produced by chemical treatment of the metal is being examined.

Tests on Quick-Frozen Foods. These include variety trials, heat extraction curves, and the determination of the rate of loss of ascorbic acid in defrosted fruits.

Physical Tests. Calculations of strain pressure in cans during processing and of the conditions required to produce dangerous distortion are worked out in the physics laboratory.

Quality Inspection. A voluntary system of quality inspection of canners' produce is in operation, and about 8,000 cans are examined annually.

UNIVERSITY OF BRISTOL, DEPARTMENT OF AGRICULTURAL AND HORTICULTURAL RESEARCH

Long Ashton, Bristol

Director:
Professor T. Wallace, C.B.E., M.C., D.Sc., F.R.I.C.

CIDER AND FRUIT JUICES SECTION

Principal Scientific Officer:
A. Pollard, M.Sc., Ph.D.

Senior Scientific Officers: 3
Scientific Officers: 3
Experimental Officer Class: 3
Other Grades: 5

General Scope of the Work

The Long Ashton Station had its origin in a scheme, initiated in 1893, with the object of promoting experiments in cider-making. The success achieved in the early years of this work was largely due to the financial support and encouragement of the Bath and West Agricultural Society. The beneficial effects of this early work on the quality of cider in the West of England aroused the interest of local County Authorities and of the Board of Agriculture, and

eventually led, in 1904, to the establishment of the National Fruit and Cider Institute with premises on the present site of the Station at Long Ashton. The National Fruit and Cider Institute continued to function as an independent body until 1912 when, at the suggestion of the Board of Agriculture, it became associated with the University of Bristol. Increased grants from the Board of Agriculture at this time enabled additional land and buildings to be purchased, and the scope of the work was enlarged to include work on fruit culture and pest and disease control. From 1919, following the first world war, further expansions of staff and work became possible, necessitating extensions of the laboratories. The latter buildings were again enlarged in 1927 and 1932. At this time, the work of the Station embraced all the more important aspects of fruit culture, including pomology, plant pathology and the control of insect pests and fungoid diseases, plant nutrition and soil studies, fruit storage, and the domestic preservation of fruit and vegetables, while continuing work on cider problems.

From 1932 onwards, the work in the Cider Section was expanded to include unfermented fruit juices and related products as a part of the general problem of fruit utilization. From the outset the two aspects of the work were integrated to a considerable degree, and by 1939 substantial progress had been made in the co-ordinated studies. In 1947, the work of the Section was re-organized, and a Technical Committee of the Agricultural Research Council was appointed; this Committee comprises representatives of the Agricultural Research Council, the Department of Scientific and Industrial Research, the Ministry of Agriculture, and the Ministry of Food, together with members appointed by the industries concerned, to act in a supervisory capacity.

The present survey deals only with the work of the Cider and Fruit Juices Section ; reports of investigations in all the Sections appear in the Annual Reports of the Research Station.

Buildings and Equipment

The facilities at the disposal of the Section comprise laboratories in the main Station building and a small factory unit for large scale experiments. The laboratory investigations are run in conjunction with the large scale processing experiments in the factory unit or ' Cider House '. The latter building is equipped with a commercial mill and press, with a capacity of two tons of fruit per hour, and the remainder of the plant is in keeping with this operational scale. It includes fermentation vessels, filters, centrifuge, chiller-carbonator, and bottling equipment ; cellar storage is available for volumes up to 17,000 gallons. Facilities are also available for small scale processing operations involving volumes of a few gallons of juice and cider. Much of the cider-making equipment is also suitable for work on unfermented fruit juices, since many processes are common to the two lines of investigation. In recent years the work on unfermented juices has been mainly on a laboratory or pilot scale basis, but it is planned to extend the scale of operations as suitable equipment becomes available.

Basic Researches in Progress

Plant Biochemistry. The chemical composition of fruit juices has been studied in relation to the changes taking place during processing operations. The work has included both major and minor constituents of apple juice and cider, viz., sugars, acids, nitrogenous substances, pectin, tannins, inorganic

constituents, and factors influencing the growth of micro-organisms. The newer methods of ion exchange and chromatography are being increasingly used, and the latter technique is also being applied in the study of the inorganic constituents of juices and ciders. The work on fruit enzymes has so far been restricted to the pectin-degrading enzymes normally present, and to their effect on juice clarification and fermentation and on changes occurring during the storage of unfermented juices. Studies of the ascorbic acid content of fruits have mainly concerned fruits with special nutritional qualities, such as black currants ; the relations between ascorbic acid content and varieties and cultural treatments have been investigated in considerable detail.

The Chemistry of Cider-Making. The changes in the composition of juices during the course of fermentation are being followed in an attempt to relate the course of fermentation with the nutritional requirements of yeasts and other micro-organisms. Particular attention has been paid to the nature of changes in nitrogenous constituents and organic acids.

The Microbiology of Cider-Making. The microbiological work includes the isolation and taxonomic classification of the yeasts and lactic acid bacteria found in apple and pear juices and in their fermented products. The changes in the numbers and species of these micro-organisms occurring during fermentation are being studied in relation to the factors responsible. A study is also being made of the relative value of different yeasts and bacteria in cider-making practice and of the effects of their addition in pure culture to juices and ciders.

Applied Studies in Progress

The Section maintains close contact with the juice and cider industries and with growers of culinary and cider fruit. The meetings of the Cider Advisory Committee of the Station and of its sub-committees on Orcharding and Cider Manufacture provide an opportunity for discussion with fruit growers and manufacturers' representatives of problems relating to fruit supplies, processing methods, and quality control. In association with the pomological section of the Station, comprehensive surveys have been carried out over many years on the orchard characters and vintage quality of the main English cider apple varieties, and lists of recommended varieties have been drawn up. Trial orchards of these varieties have also been established in collaboration with horticultural officers throughout areas in which cider apples are grown. The tests of vintage quality have been made in conjunction with chemical analysis, but organoleptic tests still remain the final criteria in the assessment of vintage quality and call for suitably trained personnel.

Juice and Cider Processing. Processing operations for unfermented juices have been restricted to small scale experiments and have involved studies of methods for juice clarification, pasteurization, and storage. The general problems of fruit utilization through the medium of juice products have received attention, and more especially those concerned with the disposal of the lower grades of culinary apples with a high acid content. In this connection, the effects of fruit storage and of ion exchange treatments in reducing the acidity of the juice have been studied in particular.

The cider work has covered the range of processes involved in cider-making. It has included studies of the suitability of specific fruit varieties for cider-making, and the effect of the stage of fruit maturity, as well as investigations of

juice and fermentation treatments and of the stability and vintage quality of the final ciders. Particular attention has been paid to methods for retaining natural sweetness in ciders by the control of fermentation, both by the use of the centrifuge and by juice pre-treatments (defecation or keeving). The use of selected yeasts for carrying out the fermentation has also been studied in relation to methods of processing and to the quality of the final cider. The work has also included tests on the pasteurization of cider, the use of juice concentrates in cider-making, and the utilization of pressed pomace for pectin production.

The subject of spray residues in apple products has been investigated ; the work has involved the determination of metals normally present in juices, ciders, and pomace products, and of those arising from spray treatments.

Advisory Work

The Section is responsible for advisory work on cider orcharding and problems in the manufacture of cider and fruit juices. The enquiries cover the whole field of fruit supplies, processing methods, the design of plant and equipment, and the quality of the final products ; they are dealt with by correspondence, by discussion, or, where necessary, by visits to factories. The work also includes analyses and tests of products and the investigation of specific problems sent in.

The Open Days of the Station and, in particular, the Annual Cider Sampling Day maintain close contact between the Section and the industries and provide opportunities for discussion of the work in progress.

THE RESEARCH ASSOCIATION OF BRITISH FLOUR MILLERS CEREALS RESEARCH STATION

St. Albans, Herts.

Director of Research:
T. Moran, C.B.E., D.Sc., Ph.D.

Assistant Directors: C. R. Jones, B.Sc., Ph.D., F.R.I.C.
J. Pace, B.Sc., Ph.D.

Staff:
P. Halton, M.Sc., Ph.D., F.R.I.C.
E. N. Greer, B.Sc., A.R.I.C.
J. B. Hutchinson, B.Sc, Ph.D., A.R.I.C.
J. J. C. Hinton, M.P.S., B.Sc., Ph.D.
N. L. Kent, M.A., Ph.D.
H. V. Hart, A.R.I.C.
H. N. Ridyard, B.Sc., F.R.I.C.
H. F. Martin, M.A.
B. Shaw, B.Sc., Ph.D., A.R.I.C.
D. J. Cosgrove, B.Sc., Ph.D., A.R.I.C.
F. G. Peers, B.A.
D. G. H. Daniels, M.A., Ph.D.
J. D. Campbell, B.Sc.

Assistant and Ancillary Staff: 29

Secretary: L. Carrington

General

The Research Association was founded in 1924. It is managed by a Council composed of 21 members of the flour milling industry, with three representatives —Professor Rideal, F.R.S., Dr. N. C. Wright (Scientific Adviser to the Ministry

of Food), and Mr. C. A. Spencer, C.B.E.—appointed by the Department of Scientific and Industrial Research. The President of the Council is Mr. L. Hector Read. In addition, the D.S.I.R., by arrangement with the Council, has appointed two visitors—Professor S. Peat, F.R.S. and Dr. T. F. Macrae, O.B.E.—who visit the laboratories at intervals and report to the Department on the progress and quality of the research that is being carried out. A small Executive Committee of the Council, under the Chairmanship of Mr. J. C. Wooler, looks after the day-to-day running of the Association.

During the second World War, the work of the Association was devoted almost entirely to the problems of the Ministry of Food and other Government Departments, and in fact, for the period March, 1943, to December, 1946, the laboratories were controlled and managed by the Ministry who named them the ' Cereals Research Station '. This title has been retained.

Buildings and Equipment

The Association is housed in two separate but adjoining buildings. The accommodation is generous and there is ample room for additional laboratory and pilot plant facilities as and when they are wanted. Special equipment includes an experimental milling block, test bakehouse, and an experimental animal unit.

General Scope of the Work

Broadly this falls into two main divisions : (a) composition, structure, and properties of wheat and flour ; (b) developments in the technology of flour milling.

Since quality in wheat is dependent on agricultural practice, intimate contact is maintained with various Institutes, including the National Institute of Agricultural Botany and the Plant Breeding Institute at Cambridge. Nutritional aspects particularly are the subject of almost continuous discussions with and reports to the Ministries of Food and Health.

On the instructions of the Council, the emphasis is on fundamental research in preference to purely applied or *ad hoc* work, and for this reason specific investigations are on occasions extended to include other cereals, notably oats, rice and maize. Routine investigations prompted by members are discouraged, but a certain amount of such work is undertaken to keep the Association in touch with the problems of the industry. On the other hand, practical problems in the mill which are obscure in their explanation or call for laboratory work to define them are tackled at once.

The Research Association covers practically the whole of the flour milling industry, and any miller will at once collaborate and make available his mill for a particular investigation. Contact is also maintained with the milling engineers through a joint Committee, and these firms have always been ready to develop any idea emerging from the laboratory work which has practical potentialities. For this reason, there has been no need for the Research Association to indulge in costly semi-commercial scale investigations.

In 1946 the Research Association entered into a five-year agreement with the Oatmeal Millers of England and Scotland to carry out research on oats and oat products. This agreement has been renewed for a further three years.

Research in Progress

The following broad programme was approved by the Council for the current year. The relevance of the individual items to cereal chemistry and/or flour milling practice is obvious.

1. *Wheat and Flour Quality:*
   (a) Assessment of quality (nutritional and baking).
   (b) The physical properties of biscuit flour doughs.
   (c) The prolonged storage of flour and the prevention of oxidative rancidity.

2. *Chemistry of Gluten and Action of Improvers:*
   (a) X-ray studies on wheat gluten (in collaboration with Prof. J. D. Bernal, F.R.S.).
   (b) Differences between strong and weak gluten.
   (c) Comparison of different improvers.
   (d) Mechanism of flour improver action and the search for new improvers.
   (e) Side effects of flour improvers, including further studies on the sulphoximines (methionine sulphoximine is formed by the action of Agene on gluten) and on certain quinones.

3. *Nutrition:*
   (a) Growth-inhibiting factors in wheat.
   (b) Chemistry of wheat proteins.
   (c) Improved methods for the estimation of vitamin B_1 in wheat, flour, and bread.
   (d) Distribution of nicotinic acid and riboflavin in wheat (also maize and rice).
   (e) Microbiological assays on wheat and flour.
   (f) The enzyme systems in wheat.

4. *Milling:*
   (a) Mechanism and control of the effects of hot conditioning of wheat.
   (b) Effects of milling temperature on flour quality.
   (c) Effects of milling variables on flour quality.
   (d) Prevention of foaming in wheat washing.

5. *Oats and Oat Products:*
   (a) Elimination of extraneous material in oat products.
   (b) Chemical analyses of different varieties and effect of environment.
   (c) Lipase activity and its control.
   (d) Oxidative rancidity in oat products.
   (e) Kilning and its effect on flavour of oatmeal.

Publications

The results of all the work are published in the scientific or technical press. Occasionally reports on *ad hoc* problems or topics of major importance to the industry are circulated to members of the Research Association as Confidential Reports. An informal printed Bulletin, which is circulated to members and Government Departments four times a year, keeps members up to date with the work of the Station. Accompanying these Bulletins are abstracts of the relevant scientific and technical literature.

BRITISH BAKING INDUSTRIES RESEARCH ASSOCIATION BAKING INDUSTRIES RESEARCH STATION

Chorleywood, Herts.

Director of Research:
J. B. M. Coppock, B.Sc., Ph.D., F.R.I.C.

Secretary: S. T. Killick, B.Com., F.C.I.S.

Research Superintendent:
D. W. E. Axford, M.A., Ph.D.

Principal Bakery Officer: J. J. Devlin

Senior Scientific Officers: 4

Scientific Officers: 7

Experimental Officers: 3

Laboratory Technicians: 13

Other Staff: 7

General Scope of the Work

The Research Association was formed in 1946. It is concerned with fundamental and *ad hoc* research into the problems of the Biscuit, Bread, Cake, and Flour Confectionery Industries. All aspects of the functions and utilization of raw materials in baking, processes of manufacture, the behaviour of the baked product, equipment, and constructional materials are covered.

Buildings and Equipment

Chorleywood Lodge, the main building, was bought in 1947, and converted to house chemical, physical, bacteriological, and other laboratories, two constant temperature rooms, a test bakery, library, and administrative offices. The Research Station was formally declared open by H.R.H. the Duchess of Kent in June, 1949. The demands made by the Industry on the Research Association soon made it obvious that an extension was required. A new building was therefore constructed adjacent to the existing one, and was opened by Dr. R. T. Colgate in September, 1951. The new building houses a pilot scale bakery, an experimental bakery with ingredient store, cool room and constant temperature mixing room, a cereals laboratory, and an analytical laboratory. Extensive baking facilities are now available. These include a pilot scale laboratory for the study of baking problems to the scale of semi-manufacturing operations and capable of undertaking plant and equipment studies. The new cereals laboratory is equipped with the most modern flour testing instruments. Comparative tests are being made on bread flours and biscuit flours to test the efficiency of these instruments and relate the results with commercial practice. Instruments are also available for testing cake flours.

Much use is made of the help offered by members of the Research Association in providing facilities for testing the results of laboratory work under factory conditions.

Research in Progress

A programme of work under the following headings is being undertaken

Bread:

1. Studies on methods in anti-staling
   (a) Physical methods, including the effect of widely different temperatures and of humidity.
   (b) Additives—the effect of chemical substances and the glycerides including fat and the glyceryl stearates.
   (c) The effect of enzyme systems.
   (d) Analytical methods of detecting chemical additives.
2. Studies on the storage of bread. The use of anti-mould agents. Physical methods of sterilization (in collaboration with a member firm). Methods of inhibiting rope development in bread.
3. Vitamin survey on bread.
4. Mineral oils in greasing operations.
5. Dough testing instruments.
6. Simple flour and dough tests for the baker : Zeleny Sedimentation Test.
7. Steels, tinned steels, and coatings for baking tins and baking sheets. Problems of corrosion.
8. Refrigeration of doughs and problems in corrosion and other surface effects in steel and coated sheets during refrigeration.
9. Flour improvers and bleaching agents, and methods of bread improvement not detailed elsewhere.
10. The efficiency of dough dividers.
11. Trace metals in bread.
12. Studies on yeast relating to its storage, age, and function in bread-making.
13. The effect of water treatment, including sterilization, on dough behaviour.

Flour Confectionery:

1. Study of emulsions, their preparation from materials of natural origin and synthetic chemicals and their uses. Analytical methods related thereto. Physical and chemical properties of emulsifying agents and their effect on emulsifying power.
2. Problems in keeping and packaging, including moisture retention, storage, anti-staling, and rancidity development in ingredients and products.
3. Batter stabilities in cake, including studies in shortening.
4. The quality of egg products and their influence on baking quality.
5. The absorption of mineral oils during processing by cakes and other flour confectionery.
6. Refrigeration in the production of flour confectionery.
7. Extraneous materials in cake and the ingredients thereof.

8. Physical measurements on cake flour.
9. Trace metals in flour confectionery.
10. Studies on the effect of various ingredients not otherwise specified on the baking qualities of flour confectionery and in certain types of speciality breads. Dry Mix methods.

Biscuits:

1. Extraneous materials in biscuits and the ingredients thereof, including couvertures.
2. Physical measurement on biscuit and wafer flours—relation to baking practice.
3. The checking or cracking of biscuits and the splitting of wafers.
4. Ice-cream wafers, cones, etc..
5. The quality and keeping properties of biscuits, studies on the development of off-flavours, the use of emulsions, the influence of moisture, air, temperature, and enzymes on the stability of shortening in biscuits.
6. Packaging problems.
7. Trace metals in biscuits.
8. The causes and prevention of fat bloom on biscuits.

General:

1. Consumer preference and tasting technique and the assessment of organoleptic characteristics.
2. Methods of heating in baking
   (a) Convection and conduction,
   (b) Radiation, including infra-red,
   (c) Electronics,
   (d) Heat transference across metals of various thicknesses and colours.
3. Review of bakery equipment and machinery
   (a) Ovens.
4. Quality testing instruments
   (a) Finished products,
   (b) Raw materials.
5. Methods of improving hygiene in bakeries, including pest and rodent control, surveys of bakery machinery and constructional materials.
6. Study of mixing operations in bakery practice, including pressure mixing.
7. Food spoilage : Survey of bacterial and mould content of baked products and ingredients, e.g. bacterial content of manufactured creams. Rancidity development in various products, e.g. creams of several types and the influence of trace metals.
8. Specifications for certain raw materials. Materials of construction and machinery, etc.

9. Analytical problems on the determination of coconut and flour in cakes and biscuits.
10. Physiological studies, including pharmacological and nutritional aspects, on certain raw materials, finished products ; materials of construction, processing, and hygiene aids under introduction into bakery practice.
11. *Ad hoc* researches as demand and facilities occur.

Publications

Results of research are published in scientific and technical journals. In addition, a considerable amount of the Association's research work is published in the *Bulletin*, which is issued bimonthly to members. Abstracts of current literature are also circulated bimonthly to members.

THE NATIONAL INSTITUTE FOR RESEARCH IN DAIRYING

Shinfield, near Reading

Director:
H. D. Kay, C.B.E., D.Sc., F.R.S.

Deputy Director: A. T. R. Mattick, B.Sc., Ph.D.

Secretary: H. F. Burgess, M.B.E., A.C.I.S.

This research institute was established in 1912 in the University of Reading. It remained in Reading till the early 1920s, when it moved out to its present site at Shinfield, some three miles from the University, the move being completed in 1923. The Institute is still part of the University.

General Scope of the Work

The Institute's research work is concerned with the scientific problems associated with the milk industry, i.e. with those arising in relation to the production, transport, quality, processing, and distribution of liquid milk, and to the manufacture, storage, distribution, and quality of milk products. Basic investigations in associated sciences are also carried out.

There are the following eight research departments :

Department	Head of Department
Dairy Husbandry:	A. S. Foot, M.Sc.
Feeding and Metabolism:	S. Bartlett, M.C., B.Sc, Ph.D.
Physiology:	S. J. Folley, D.Sc., Ph.D., F.R.S.
Bacteriology:	A. T. R. Mattick, B.Sc., Ph.D.
Chemistry:	S. J. Rowland, B.Sc., Ph.D., F.R.I.C.
Physics:	G. W. Scott Blair, M.A., D.Sc., Ph.D., F.R.I.C., F.Inst.P.
Dairy Engineering:	H. S. Hall, B.Sc.
Nutrition:	S. K. Kon, D.Sc., Ph.D., F.R.I.C.

There are also three smaller sections :

Statistics:	C. P. Cox, M.A.
Isotopes:	R. F. Glascock, B.Sc., Ph.D.
Experimental Dairy:	Helen R. Chapman, N.D.D.

Of the departments shown above, the first three deal mainly with the problems, both immediate and fundamental, associated with the technique and physiology of milk production, and the other five deal, in their respective spheres, with the application of science both to farm production and to the more strictly industrial side of practical dairying. All are inevitably concerned from time to time with problems directly affecting the consumer of milk and milk products.

Much of the work of the Institute is carried out in close collaboration with dairy farmers and organizations of milk producers, or with distributors of liquid milk, or with makers of milk products. The departmentalization within the Institute is for convenience only and there is very extensive internal collaboration on the majority of the research projects. The scientific staff, including a number of post-graduate research students, is at present (February, 1953) 85, and is housed in the Manor House, in a laboratory block built in 1938, in an engineering block erected in 1946, and in a number of Nissen and other huts put up since the end of the war. The Institute's two farms extend over 800 acres ; an attested dairy herd of over 230 animals (including young stock) is maintained, together with 300 to 400 pigs, and some 60 to 80 goats. All these animals are used for different types of experimental work (see below). Smaller laboratory animals are maintained for bacteriological, physiological, and nutritional investigations.

Research in Progress

Physiology and Biochemistry of Reproduction and Lactation (with special reference to the dairy cow) :

Endocrine control of mammary growth and lactation ;
Physiology of milking and suckling ;
The formation of milk and the origin of the milk constituents ;
Reproduction ; pregnancy tests in the cow, rheology of cervical secretions, metabolism and fertility of sperm.

Feeding, Digestion and Metabolism of the Bovine in relation to Lactation:

The evaluation of grassland crops and other crops in terms of milk production;
The efficiency of food utilization by the ruminant ;
Factors affecting the yield and composition of milk ;
Colostrum in relation to health, growth and development of calf ;
Role of intestinal flora in nutrition and in milk quality.

Milk—Production, Keeping Quality, Faults, Processing:

The technique of milking ;
Effect of cow ' management ' on yield and composition of milk ;
Machine milking ; the management of milking machines ;
Disinfection of apparatus, utensils and plant ;
Destruction of micro-organisms in milk by various physical means ;
Tests for acceptance of milk on the creamery platform ;
Inhibitory substances in milk ;
Industrial pasteurization and sterilization of milk.

Chemistry and Physics of Milk and Milk Products:

New or improved analytical methods ;
Milk composition during spring grazing ;
Keeping quality of dried milk ;
Milk and cream enzymes ;

Proteins of milk ;

Physical properties of milk and its products. Osmotic studies, colour, thermal, electrical, and optical properties, foaming in milk and milk products, rheology, cream structure ;

Rheology of butter and cheese.

Microbiology of Milk Products:

Flora and enzymes of cheese in relation to ripening and flavour ;

Blue cheese and other special types, control of gas formation ;

Bacteriology of butter in relation to keeping quality and flavour ; effect of blending or re-working on keeping quality ;

Sour milk products, preparation and flora.

Nutritional Value of Milk and Milk Products :

Methods for vitamin assay—chemical, physical, biological, and micro-biological.

Recently discovered members of vitamin B group ;

Conversion of carotene into vitamin A ;

Stability of riboflavin in milk ;

Effect of processing and storage of milk products on the biological value of milk proteins ;

Effect on growth rate of antibiotics added to the diet.

Other Projects :

Nisin and other antibiotics from milk organisms ;

The characterization and classification of streptococci, lactobacilli and other lactic acid organisms ;

Psycho-physical studies of judgment and grading, particularly of milk products.

The engineering department carries out, under a Ministry of Agriculture scheme, performance tests and other trials of new and of prototype machines and appliances that are in process of manufacture by engineering firms for use in the dairy industry. For this purpose, it is not infrequently necessary to devise, and carry out trials of, new methods of machinery testing.

Publications

Interim statements on research in progress are to be found in the annual reports of the Institute. Research results are published in well-known scientific journals, and also in the farming and dairy trade press. Special bulletins, containing reports not suitable for scientific or industrial journals, are, from time to time, published independently by the Institute, or by the Commonwealth Agricultural Bureau (by arrangement).

THE HANNAH DAIRY RESEARCH INSTITUTE

Kirkhill, Ayr

Director:
J. A. B. Smith, D.Sc., Ph.D., F.R.I.C.

Department	Head of Department
Grassland and Dairy Husbandry:	W. Holmes, B.Sc., Ph.D., N.D.A., N.D.D.
Bacteriology:	Constance Higginbottom, M.Sc., Dip. Bact., Ph.D.
Biochemistry:	E. C. Owen, B.A., B.Sc., M.Sc., Ph.D.
Nutrition:	K. L. Blaxter, D.Sc., Ph.D., N.D.A.
Pathology:	P. S. Blackburn, Ph.D., M.R.C.V.S.
Physiology:	J. D. Findlay, B.Sc., Ph.D.
Technical Chemistry:	R. Waite, M.Sc., Ph.D.

Other Qualified Staff: 22 *Technical Assistants:* 26

Secretary: Miss M. M. Hughes

The Institute was founded in 1928, the original buildings being opened in 1931. Considerable extensions were made available in 1951. The Council of the Institute is composed of three members nominated by the University of Glasgow, three by the West of Scotland Agricultural College, and two by the Secretary of State for Scotland. Post-graduate work can be done at the Institute in preparation for higher degrees at the University of Glasgow.

General Object

The Institute's function is to engage in research work on many widely differing problems connected with the dairy industry. These problems range from grassland management and the growing of feeding-stuffs for dairy stock, through calf and cow nutrition and milk production itself and factors affecting it, to the manufacture, preservation, and utilization of milk products.

Buildings and Equipment

The main Institute building contains well-equipped laboratories for the study of problems in bacteriology, biochemistry, nutrition, pathology, physiology, and technical chemistry. In the last few years the buildings have been greatly extended ; one of the new additions consists of a large milk-processing room, which is used for the study of problems associated with the manufacture, packing, and storage of evaporated and dried milk products. The buildings at the farm include a metabolism house with stalls for nine cows, which is specially equipped for detailed studies on the digestibility and food value of feeding-stuffs. There is also equipment for respiration and energy studies on calves. The buildings on the farm include a climatic room for studying the environmental physiology of cattle.

Research in Progress

It will be impossible in the space available to give a complete account of the work in progress, but typical examples are given to illustrate its scope.

Grassland and Dairy Husbandry

On the farm of 135 acres, extensive long-term experiments are being made to determine methods by which British dairy farming can become less dependent on imported feeding-stuffs. This involves research work on the cultivation, conservation, and utilization of grass and other crops. Other problems associated with milk production are also being studied.

The following are some of the topics under investigation on the farm :

The influence of nitrogen, phosphorus, and potassium, and their interactions, on grassland production and on the protein, mineral and trace element composition of grass ;

A comparison of pure strains and species of grass and their responses to legume nitrogen and to synthetic nitrogen ;

The close-folding of dairy cattle and the behaviour of grazing animals under different conditions of management ;

The determination of the daily food intake of cattle at pasture in relation to age, live weight, and stage of lactation ;

Farm problems associated with the winter feeding of grassland products, and the value for milk production of herbage of different species and produced at different seasons.

Biochemistry

Factors affecting the composition of milk and colostrum—particularly the effect of substances like thyroxine and thiouracil on the minerals, vitamins, and enzymes of milk ;

A study of the partition of phosphorus and the nature of phosphorus compounds in milk ;

The effect of hormones on the metabolism of carotene and vitamin A in ruminants ;

Some aspects of the biochemistry of rumen bacteria and protozoa.

Nutrition

Many important problems connected with calf nutrition, including work on vitamin E metabolism, cod liver oil feeding, and the development of muscular dystrophy ;

Energy metabolism studies in calves and sheep ;

Amino acid requirements of calves ;

Magnesium metabolism in calves and cows ;

The efficiency of feed utilization by lactating cows of different breeds.

Physiology

The effect of exposure of calves under accurately controlled conditions to different temperatures and humidities on their cardio-respiratory and heat loss mechanisms ;

The study of moisture transudation in bovine skin, and peripheral blood flow in cattle ;

The comparative histology of the skin of tropical and European breeds, with special reference to the ' sweat glands ' and blood supply.

Pathology

Various problems assoeiated with mastitis and the composition and ccll count of milk.

Bacteriology

Various problems connceted with the bacteriological quality of milk and milk products, the assessment of quality, and the maintenance of high quality in milk supplies ;

Fundamental studies on the micro-organisms of the rumen and on the nutritional requirements and metabolic products of certain micro-organisms.

Technical Chemistry

The influence of heredity and environment on the solids-not-fat composition of milk ;

The effect of the mineral eonstituents of milk on the stability of its protein ;

Factors affecting the drying and condensing of milk ;

The chemistry of grasses and legumes, with special refcrence to the water-soluble earbohydrates at different stages of growth.

Publications

Further details will be found in the reports of the Institutc and in the printed list of publications, eopies of which can bc obtained on application to the Secretary.

HERRING INDUSTRY BOARD

The Herring Industry Board was constituted by the Herring Industry Act of 1935, charged with the duties of reorganizing, developing, and regulating thc industry. Both the first and the later Acts (1938, 1944 and 1948) lay down in broad, general terms the powers and duties of the Board. The preeise means whereby and extcnt to whieh the Board may exercise its powers in carrying out its duties are set out in Statutory Instruments, the latest of which, replacing all earlier Instruments, is the Herring Industry Scheme, 1951 (No. 1478 of 1951).

The Ministers by whom the Board is appointed, and to whom the Board reports, are the Secretary of State for Scotland, the Minister of Agriculture and Fisheries, and the Secretary of State for the Home Department. For the purposes of seetions 7, 8 and 9 of the White Fish and Herring Industries Act, 1948, the Minister of Food is also one of the Ministers responsible.

The Board is advised on Trade matters by the Herring Industry Advisory Counеil, the members of which are appointed by Ministers. Although the members of the Advisory Council serve in their personal capacities, they are seleeted as persons representative of the interests of the different sections of the herring industry and of persons cmployed in the industry. The Chairman of the Advisory Council is a Mcmber of the Board, and is chosen by the Board. This appointment is at present held by Sir Frederick A. Bell, O.B.E., M.C., thc Chairman of the Board. The other Members of the Board are Sir T. George Wilson, LL.D., and Mr. G. C. Wilson, O.B.E.

HEADQUARTERS

1 Glenfinlas Street, Edinburgh, 3

Chief Executive:
H. H. Goodwin, M.B.E., F.C.A.

Secretary: T. H. Wilson

Staff. Owing to the nature of the industry and the widely scattered locations of the Board's activities and interests, the Senior Staff are to some extent peripatetic, although their principal place of business is Headquarters.

Administrative responsibility in the several spheres is divided between the following Executive Officers, whose titles indicate the general range of their subjects. (The tasks of the Board are too numerous and varied to be set out in detail here.)

Chief Fisheries Adviser.

Development and Production Officer.

Staff Engineer.

Transport and Storage Officer.

Marine Superintendent.

Marketing Officer (Home).

Marketing Officer (Overseas).

Budgetary control, accounts, and statistics are the responsibility of the Chief Accountant. The Chief Clerk is concerned with internal administration and deals with all personnel matters, other than those relating to industrial workers in Field Establishments. The Personal Assistant to the Chief Executive co-ordinates the work of all Sections.

FIELD ESTABLISHMENTS

(a) *Regulation of the Fishing:* Officers of the Staff of the Chief Fisheries Adviser are stationed at the following major ports of landing of herring during the various herring fishing seasons: Lerwick, Stornoway, Wick, Ullapool, Gairloch, Mallaig, Tarbert (Loch Fyne), Oban, Portpatrick, Ayr, Newhaven, Anstruther, Aberdeen, Fraserburgh, Peterhead, Whitby, Scarborough, Grimsby, Great Yarmouth, Lowestoft and Dover. By arrangement with the Ministry of Commerce, Northern Ireland, officers of the Fisheries Division of that Ministry act as Local Officers for the Board at the ports of Portavogie, Ardglass, Kilkeel, and Annalong during the herring fishing season in local waters.

The duties of these officers include, *inter alia*, determination of the suitability of particular catches of herring for particular usages and the inspection of pickle-cured herring and kippers for certain markets abroad.

(b) *Quick-Freezing Factories and Low Temperature Cold Stores:* Lerwick, Stornoway, Port Glasgow.

(c) *Mechanized Kippering House:* Lerwick.

(d) *Ice-Making and Ice Storage:* Lerwick, Stornoway, Ullapool.

(e) *Reduction Factories:* Wick, Stornoway, Great Yarmouth.

(f) *Pilot Scale Cannery and Canning and Herring Products Research Station:* Port Glasgow.

(g) *Research Vessel, "Silver Scout".*

DEVELOPMENT OF PLANT AND PROCESSES

Article 8 (m) of the Herring Industry Scheme, 1951, provides that: "If it appears to the Board necessary, in order to secure proper provision for the needs of the herring industry, they may, after such consultation as may be practicable with such persons or organizations, if any, as appear to them to be representative of the interest concerned, take such steps as they consider advisable for the promotion of research and experiment in connexion with the herring industry and themselves carry out such research and experiment."

The Board's policy is to "promote" research, particularly fundamental research, by the agencies which already exist for that purpose. In order to avoid overlapping and duplication of effort, it confines its own activities mainly to the development, for commercial advantage, of such findings as appear to be suitable for and capable of economic exploitation.

In pursuance of this policy, the Board has engaged and is engaging in experiments and development work in many branches of the industry. The work ranges from devising means of obtaining more regular supplies of fresh herring at lower costs of production to achieving the fullest utilization of the raw material and of by-products by means of the latest techniques and machinery. For these purposes, the following activities are in progress:

(i) Both independently and in association with the Fisheries Departments, the Board is exploring the possibility of obtaining more adequate and regular supplies of herring and of reducing the costs of fishing:

(a) by the systematic locating of herring and tracking of shoal-movements, so as to eliminate waste of catching effort, and

(b) by devising new means of capture, e.g. new and less expensive types of net, electric-field fishing.

(ii) The Lerwick factory was set up to translate to full commercial scale the pilot scale work on quick-freezing of herring which was carried out first by the Torry Research Station of the Department of Scientific and Industrial Research, and later by the Board and commercial concerns in association with the D.S.I.R. and the Ministry of Food.

Also at Lerwick, the Board operates a commercial scale mechanized kippering plant, using kilns based on the Torry Research Station model. The object is to devise means of ensuring a uniformly high standard of quality in kippers, at a lower cost of production than can be achieved by using the traditional vertical kiln. Work is about to begin on the development of brining equipment which will filter, clean, and reconstitute brine by mechanical means and control the brining time in accordance with the needs of the type and condition of herring being processed.

(iii) The Stornoway ice-making plant was acquired for the purpose, *inter alia*, of developing a commercially satisfactory method of freezing herring in bulk in ice cans, in order to reduce the cost of preparing individual packages.

(iv) Experiments on packaging methods and with new materials are constantly being carried on, both at the Board's factories and in conjunction with interested manufacturers.

(v) In association with a prominent trade concern, a manufacturer of fish-handling machinery, and a professional time-and-motion-study consultant, the Board has made considerable progress towards the mechanization of the process of pickle-curing.

(vi) In the canning of herring, the Board is engaged, at the Port Glasgow factory, in carrying out a programme ranging from near-fundamental research to quasi-commercial scale operations. In this particular activity, it is advised and assisted by a Technical Committee, consisting of scientists representing the British Food Manufacturing Industries Research Association, the D.S.I.R., and the Scottish Marine Biological Association, and of scientists and production specialists drawn from the canning industry. The improvement of canned herring packs by pre-treatment of the fish is the main problem which is being examined at present ; but, concurrently, work is being carried out with the object of producing sauces which retain their consistency and appearance after retorting.

(vii) The Wick factory was built and equipped to develop, and to exploit on a commercial scale, a chemical process for recovering edible oil and protein for human consumption from herring surplus to the day-by-day requirements of the markets, and from the herring offal derived from the processes of kippering, canning, and pickle-curing ; the technical feasibility of this method of reduction was established on the laboratory scale at the Torry Research Station.

THE WHITE FISH AUTHORITY

Functions and Organization

The White Fish Authority was set up by the Sea Fish Industry Act, 1951, with the functions of re-organizing, developing, and regulating the white fish industry and keeping generally under review matters relating to the industry. In carrying out these functions, the Authority is also required to have regard to the interest of consumers in a plentiful supply of white fish at reasonable prices, as well as to the interests of the different sections of the white fish industry itself.

The Ministers by whom the Authority is appointed, and to whom it reports, are, under the Prime Minister, the Minister of Agriculture and Fisheries, the Secretary of State for Scotland, the Minister of Food, and the Secretary of State for the Home Department.

The Authority was appointed on 31st May, 1951, as follows :

Admiral Sir Robert L. Burnett, G.B.E., K.C.B., D.S.O., LL.D., *Chairman.*
Mr. W. Yeaman, *Deputy Chairman.*
Mr. H. J. Johns, C.B., M.B.E.
Mr. G. C. Wilson, O.B.E., J.P.
Mr. C. J. Knight.

All the members, with the exception of Mr. Knight, are full-time members, and were in fact appointed as members-designate in September, 1950.

A Scottish Committee of the Authority was appointed, under the powers provided by the Act, to advise the Authority on the exercise and performance of its functions as respects Scotland, and to exercise such of the Authority's functions as respects Scotland and Scottish matters as may be delegated to the Committee by the Authority.

The members of the Scottish Committee are, in addition to the Deputy Chairman of the Authority, who is Chairman of the Committee :

Captain J. S. Allan, D.L., F.R.I.C.
Mr. A. H. B. Grant.
Mr. J. Sullivan.
Mr. R. D. Winton, C.A.

All the above, with the exception of the Chairman, are part-time members.

By an Order-in-Council, dated 4th October, 1951, Part I of the Sea Fish Industry Act, 1951, was extended to Northern Ireland. The Scottish Committee was re-named the Committee for Scotland and Northern Ireland, and Major A. R. Booth was appointed an additional part-time member of the Committee to represent Northern Ireland.

A White Fish Industry Advisory Council has been appointed for the purpose of giving advice to the Authority about the exercise and performance of its functions generally. The Chairman of the Council is the Chairman of the Authority, Admiral Sir Robert Burnett, and the Council now consists of fifty members appointed to represent the interests of the different sections of the industry, of persons employed in the industry, and of consumers.

The headquarters of the Authority have been set up at Conyngham Hall, Knaresborough, Yorkshire, which is centrally situated between the major English fishing ports, and is also exactly equidistant between London and Edinburgh. The offices of the Scottish Committee are at 17, Rutland Square, Edinburgh. Area Offices have been established at Milford Haven, Plymouth, North Shields, and Aberdeen, and it is proposed to appoint further area officers to cover other parts of Great Britain and Northern Ireland.

The Authority's income is derived from a general levy at a rate of $\frac{1}{2}$d. per stone imposed on the first-hand purchase of white fish.

Powers and Duties

In carrying out its general functions, the Authority has power :

(i) To carry on research and experiment, either alone or in collaboration with others. The Authority has underwritten part of the cost of experimental voyages to the North West Africa, to seek to establish the presence of profitable fishing grounds there ; it has also appointed staff to work at the Torry Research Station of the Department of Scientific and Industrial Research, to assist in the Station's work on the development of an efficient method of freezing fish at sea, with a view to raising the quality landed, and in the development of a test for fish quality which can be applied easily and quickly to fish on landing.

(ii) To encourage and assist financially voluntary arrangements, on a co-operative basis by persons in the industry, for the selling of fish and the buying of gear and supplies and, if thought necessary in any locality, to undertake itself the buying and selling of fish and supplies.

The carrying out of this function will be one of the main duties of the staff of the Authority at Area Offices.

(iii) To promote the export of white fish by various means. So far, help has been confined to exporters of dried salt fish.

(iv) To provide or acquire fishing vessels and processing plants. Studies are now being made in various localities of the needs of areas for fish meal plants, in order to utilize available supplies of fish offal.

(v) To make loans to others for acquiring fishing vessels, gear, and processing plants. Arrangements are now in operation for loans for the construction, acquisition, reconditioning or improving of fishing vessels of all sizes up to 140 feet in length, and of plants for processing white fish. In addition, the White Fish and Herring Industries Bill will, when it becomes law, enable the Authority to make grants towards the construction of new vessels up to 140 feet in length. The ultimate aim of grants and loans for vessels is to replace the old and uneconomic vessels which at present form a large proportion of the British inshore, ' near ' and ' middle ' water fishing fleets.

(vi) To make grants for maintenance of persons undergoing training courses. Grants have been made for up-grading courses at Grimsby and Lowestoft.

(vii) To encourage, by publicity and other means, the improvement of conditions in the industry and the greater consumption of white fish.

Besides the above general powers, the Authority may also make Regulations, after following the procedure for advertisement and consultation laid down in the Act, for the purposes of :

(a) regulating the handling and stowage of white fish on board fishing vessels and on and after landing ;

(b) timing the landings of white fish to secure regularity of supply ;

(c) regulating the sale of white fish and its conditions of sale, other than price ; and

(d) prescribing standards of quality for white fish and limiting the purposes for which fish of any of the standards may be used.

While no Regulations have so far been made on these subjects, the Authority is preparing draft Codes of Practice in respect of handling white fish at sea and on shore and in respect of quick-freezing of fish. These Codes will set standards of behaviour and will serve as a guide to the industry in ensuring the highest standards of handling, marketing, and distribution. In the light of experience gained in the operation of the Codes, it is intended to draw up Regulations incorporating those provisions which have proved practicable and desirable. Close liaison is being maintained with the Department of Scientific and Industrial Research, and also with the Food Hygiene Division of the Ministry of Food, which is itself, after consultation with the Authority, preparing fresh Regulations under the Food and Drugs Acts, dealing mainly with hygiene and cleanliness at the later stages of distribution.

The Authority has made suggestions to the industry regarding timing of landings, but the climatic and psychological difficulties are serious and will not be easily overcome, particularly as action must avoid any lengthening of voyages, with the consequent deterioration in quality of fish landed.

Proposals for re-organization and development of the industry have to be embodied in statutory Schemes, which, before confirmation by Ministers, are subject to an affirmative resolution of both Houses of Parliament. Draft Schemes for the improvement of marketing at the smaller ports, and for the quick-freezing of good quality fish during times of glut and its storage and eventual release to the trade during periods of shortage, are now under active consideration.

Transportation of white fish, and the techniques and containers used for transport, are other matters which are the subject of close study by the Authority, with a view to the improvement of quality of fish offered to the consuming public.

REFRIGERATED CARGO RESEARCH COUNCIL

Cunard House, 88 Leadenhall Street, London, E.C.3

Chairman:
A. I. Anderson

Secretary: A. E. Alcock

Falcon Yard, Cambridge

Technical Director: K. C. Hales

The Refrigerated Cargo Research Council was formed by an association of British shipping companies engaged in the carriage of refrigerated cargo in the South African, South American, Australian, New Zealand, and North Pacific trades. Its aim was to continue the work formerly carried out by the Low Temperature Research Station at Cambridge and the Ditton Laboratory at East Malling, Kent, in applying the results of laboratory research to the practice of marine refrigeration. The Council is managed by Executive and Technical Committees consisting of representatives from the Lines concerned. Close contact is maintained with the Food Investigation Organization of the Department of Scientific and Industrial Research in this country and with the corresponding research organizations in the food-producing countries overseas.

The object of the Council is to enable shipping companies to make the best use of the latest scientific knowledge in carrying perishable commodities as efficiently and economically as practicable. There are broadly two sides to this work. One is to apply to practical operation the results obtained by research organizations working on the more fundamental aspects of food preservation. The other is concerned with the design and operation of refrigerated cargo spaces. The aim here is to improve the control of those factors, such as temperature, which affect the quality of food-stuffs and to ensure that the required degree of control is obtained in the most economical way.

The greater part of the research work of the Council is done on the ships of the member Lines during their normal voyages. A laboratory is maintained at Cambridge, where the Council's technical staff is based. The work of the laboratory is mainly physical in character. Some problems, particularly those

associated with the design of refrigerated spaces, can be investigated more usefully in the laboratory than on a ship. The results of such research are, however, linked to similar investigations, perhaps less wide in range, on actual refrigerated spaces.

It has always been a matter of policy that the sea-going staff of the member Lines should be brought into the Council's work wherever possible. A number of refrigerating engineers have been seconded to the Council for periods of six months or longer. They have then worked in the Council's laboratory as members of the research staff. This has served the two-fold purpose of enabling the sea-going refrigerating engineer to appreciate the problems behind his day-to-day experience, and of enabling the research worker to gain a clearer idea of the problems of operation. The observations required for the experiments during ships' voyages are taken, in the main, by the ship's officers. The experiments have to be designed so that no excessive time is required to take the necessary readings and that the instruments used should require no more skill and experience than those in common use in the modern ship.

An example of research of current concern, conducted almost entirely on board ship, is an investigation of the effect of stowage and wrapping on the carrying conditions of Brazilian bananas. Investigations into the use of ozone on board ship are an example of combined laboratory and shipboard research. An evaluation of the most economical insulation for a refrigerated ship is an example of laboratory research conducted entirely with models and by calculation.

PEST INFESTATION LABORATORY OF THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Slough, Bucks.

Director:
G. V. B. Herford, O.B.E., B.A., M.Sc.

Senior Principal Scientific Officer:
E. A. Parkin, Ph.D., M.Sc., D.I.C.

Principal Scientific Officers:
T. A. Oxley, B.Sc., A.R.C.S.
W. B. Brown, M.Sc., F.R.I.C., A.R.C.S., D.I.C.
M. E. Solomon, M.Sc.

Senior Scientific Officers: 4

Scientific Officers: 5

Experimental Officer Class: 27

Other Grades: 29

General Scope of the Work

The Pest Infestation Laboratory was established in 1940, at the request of the grain handling industry, to undertake research on the control of insect pests in stored food-stuffs, especially in stored cereals.

Since that time, the terms of reference have been somewhat widened to include, for example, insects which attack certain other stored products (e.g. tobacco), and those insects which may be classed as ' domestic ' pests (clothes moths, carpet beetles, ants, cockroaches, house-flies, blowflies, etc.).

Executive responsibilities are undertaken by the Infestation Control Division of the Ministry of Agriculture and Fisheries. The majority of enquiries go automatically to this Division. The Laboratory maintains contact with practical problems by close liaison with the officers and inspectors of this Division.

The Laboratory is becoming increasingly interested and concerned in infestation problems in the Colonial Empire, and a Colonial Liaison Officer has been appointed to facilitate the exchange of information between the Laboratory and those confronted with food storage problems in the Colonies.

Organization

The work of the Laboratory is organized in five Sections, concerned with Biology, Grain Storage, Insecticides, Fumigants, and Biochemistry.

Biology Section. Fundamental to any work on control measures is a knowledge of the biology and behaviour of the insects and mites themselves. Work has therefore been undertaken on the more important species, having particular regard to rates of development under different conditions of temperature and humidity and to the rate of population increase, as well as to the physical conditions that limit their existence and the complete development of the different stages. Whenever possible, the results of laboratory experiments are checked against observations in the field.

Other investigations include: residual insect populations in empty warehouses; disused birds' nests as a likely source of infestation of houses by carpet beetles, clothes moths, and the like.

Grain Storage Section. This Section is responsible for studying those problems, other than entomological, which are inherent in the safe storage of food-stuffs. At present, attention is being concentrated on grain storage, including fungal infestation, the respiration and heating of grain, grain drying, and the design of storage accommodation. Much of this work has a direct bearing on urgent Colonial problems.

Insecticides Section. This Section is responsible for research on all types of control methods, other than fumigants. These include the use of sprays, dusts, smokes, etc., as used for the disinfestation of empty silos, warehouses, food stores, and ships' holds, and for the surface treatment of infested commodities. Special attention is being given to the possibility of using the newer synthetic insecticides against stored product insect pests, and work is in progress on the important question of the contamination of food-stuffs by these materials.

Insects vary widely in their resistance to insecticides, and many factors may affect this variation. A long-term study is being made of this problem, the results of which should make a valuable contribution to the whole question of insecticidal control.

The control of blowflies infesting slaughter-houses is also being investigated.

Fumigants Section. Fumigation provides a very effective, and sometimes the only, method of killing insects that have penetrated deeply into stored produce. By this means, it is possible to reach insects that are in the middle, say, of a silo bin of grain or within boxes of dried fruit.

The study of the toxicity of fumigants to different insect species, and the effect of temperature and other factors upon resistance, constitutes an important part of the work.

Investigations are also undertaken on the behaviour of gases in food-stuffs; the penetration, sorption, and ultimate removal of the gases is studied in the

laboratory, and, on the full scale, in warehouses, etc. For large scale work, a mobile laboratory has been equipped and has proved invaluable.

Many of the gases used in fumigation are highly poisonous to man, and it is necessary to ensure that products treated with them are not rendered harmful. Special attention is given, therefore, to the chemical reactions of fumigants with food-stuffs and their constituents.

Biochemistry Section. The work of this Section is concerned mainly with: (1) the detailed study of the reactions of fumigants and insecticides with treated food-stuffs, and (2) research on the mode of action of such toxic materials in the insect body.

The extreme sensitivity of methods based on the use of radioactive material has led to the use of these methods in both these lines of work. For example, by combining these techniques with the use of paper chromatography, it has been possible to measure quantitatively the extent of the reaction of labelled methyl bromide with the several amino acids of hydrolysed wheat protein, and to demonstrate the ability of ' DDT-resistant ' house-flies to dehydrohalogenate the DDT to a non-toxic ethylene derivative.

General. The Laboratory has an up-to-date library, and facilities for glass blowing, instrument making, and photography.

INFESTATION CONTROL DIVISION, MINISTRY OF AGRICULTURE AND FISHERIES

Hook Rise, Tolworth, Surrey

Administrative Head:
H. N. White

Scientific Head:
J. W. Evans, M.A., D.Sc., Sc.D.

Principal Scientific Officers:
J. A. Freeman, B.Sc., Ph.D., A.R.C.S. (Chief Entomologist)
E. E. Turtle, M.B.E., M.Sc., Ph.D., A.R.C.S., F.R.I.C. (Chief Chemist)
Miss M. D. A. Lawrence, B.Sc. (in charge, Rodent Field and Instructional Branch)
E. W. Bentley, B.Sc., Ph.D. (in charge, Mammals and Birds Research Branch)

Chief Insect Inspector: F. R. Cann, D.I.C.

Chief Technical Officer:
C. D. Hornby, M.Sc., A.R.I.C.

Senior Scientific Officers: 9

Scientific Officers: 2

Experimental Officer Class: 50

Other Scientific Grades: 8

General Scope of the Work

The Division came into existence in 1941 as a part of the Ministry of Food. It was set up to provide a service to prevent and reduce losses of stored food and certain other commodities, due to insect, mite, and rodent infestation. When, in 1947, it was transferred to the Ministry of Agriculture and Fisheries, the Division assumed responsibility also for the control of other injurious mammals and of birds harmful to agriculture. Since 1952, it has been responsible for the control of insect and rodent infestations in Crown Property formerly undertaken by the Ministry of Works.

The Division is responsible for the implementation of certain Acts of Parliament, in particular the Prevention of Damage by Pests Act (1949) and those sections of the Agricultural Act (1947) relating to the control of injurious mammals and birds.

Organization

There are four scientific sections, namely, the Entomological Section, the Chemical Section, the Rodent Field and Instructional Section, and the Mammals and Birds Research Section. Only the last-named is wholly occupied with research, although investigations of a limited nature are sometimes conducted by the others.

On the executive side of the Division, control of insect infestations is arranged by Insect Inspectors (Experimental Officer Class), control of injurious mammals and birds by Pest Officers attached to County Agricultural Executive Committees, while such rodent control matters in urban areas as are the responsibility of the central government are handled by Divisional Rodent Officers.

Entomological Section. This Section is responsible for the provision of such entomological information as is necessary for this side of the work of the Division. It determines the methods to be used by the Inspectors for the discovery and measurement of insect infestation and for the assessment of results of control; it also organizes and conducts training courses in stored products entomology, both for new recruits and for grain storage officers and others from overseas territories, and it collects and analyses information relating to the insect and mite infestation of imported and stored goods.

Entomological problems arising in the field are dealt with on the basis of existing knowledge; in instances where appropriate knowledge is lacking, research problems are drawn to the attention of the Pest Infestation Laboratory of the Department of Scientific and Industrial Research, with which the Division works on a basis of close co-operation.

In addition to Headquarters staff, entomologists on the strength of the Section are attached to the principal Area Offices (which are in charge of Senior Inspectors). Their function is to provide a specialized entomological service for inspectors. They also undertake a limited amount of field investigation.

Chemical Section. This Section is responsible for all chemical matters pertaining to pest control which fall within the sphere of the Division. On the entomological side, it decides the techniques to be used for the control of insects and mites, and in regard to other pests it provides advice on and, where necessary, investigates the properties, or action, of rodenticides and fumigants. The staff of the Section takes part in the instructional courses provided by the Division; in co-operation with Insect Inspectors, it reviews insect and mite control methods and determines requirements for further research. In co-operation with the staff of the Pest Infestation Laboratory, it also takes part in the field development of new control techniques.

In addition to staff at Headquarters, a local chemical service is provided at the Liverpool Area Office.

Rodent Field and Instructional Section. Members of the staff of this Section, who are stationed at various centres, are responsible for the provision of training courses on Ministry-approved methods of rodent control. These are

given to people such as Medical Officers of Health, Sanitary Inspectors, Divisional Rodent Officers and Inspectors, Rodent Operatives, and, on occasion, to Government-employed personnel from overseas. They also undertake field experimental work in the development of new rodent control techniques, provide a specialist advisory service on rodent control matters generally, and, on request, investigate and report on particularly difficult infestations.

Mammals and Birds Research Section. The Division is responsible for research in regard to mammals and birds, although not in regard to insects. At present, research is in progress in relation to the control of the brown rat, ship rat, house mouse, and the rabbit, and ornithological investigations are contemplated. In addition to direct trials of control measures, by means of both cage and field tests, ecological, behaviour, and more fundamental studies are undertaken.

Insect Inspectors. These are stationed at the principal ports and in certain centres elsewhere. They inspect food-stuffs on arrival from overseas, in store, and during transport and processing; ascertain the precise nature of infestations; assess their significance with regard to intentions for further storage or distribution, and, when necessary, recommend control measures, supervise their execution and assess the results. They also assist the chemical and entomological sections and the Pest Infestation Laboratory in field investigations. Insect Inspectors are responsible for directing the work of Pest Destruction Operators carrying out insect control in Crown property.

Pest Officers. These are on the staffs of County Agricultural Executive Committees and are responsible for matters relating to the destruction of injurious mammals (e.g. rats, rabbits, grey squirrels, deer, foxes, moles, etc.), and birds harmful to agriculture.

Divisional Rodent Officers. These provide a liaison between the Ministry and Local Authorities on matters pertaining to rodent control. They are also responsible for rodent control in premises occupied by the Ministry of Food, and have certain other functions.

General. The laboratories at Tolworth are equipped with animal rooms and constant temperature chambers. There is a photography section, a workshop, and a small library.

THE PRINTING, PACKAGING AND ALLIED TRADES RESEARCH ASSOCIATION

Leatherhead, Surrey

Director of Research:
G. L. Riddell, Ph.D., F.R.I.C.

Research Superintendent:
W. H. Banks, Ph.D.

Information Officer:
G. Macdougall, Ph.D.

The Printing, Packaging and Allied Trades Research Association was first formed (as the Printing Industry Research Association) in 1931, receiving a grant from the Department of Scientific and Industrial Research in 1935. The first research laboratories, opened in 1937, were destroyed in an air-raid on London in May, 1941 ; after the use of temporary accommodation, a site at Leatherhead, Surrey, was developed, and the present research building, having a floor space of some 25,000 square feet, was opened in October, 1948. Packaging was added to the research programme in 1944, at the request of the industry, and the name of the Association was altered to include this new Division.

Although there are some aspects of printing which concern food packaging —e.g. the fading of printed packages on exposure to light, the staining of the package by the food product (and vice-versa), or the incompatibility of the food product and the printing—the main contact which PATRA has with the food industry is via its Packaging Division ; this note will be confined of the activities of that Division. The Printing Division is about twice the size to the Packaging Division. The total staff of the Association is about 75.

The work of the Packaging Division is grouped under three headings : Information ; Advisory and Testing Services ; and Research.

Information

In the Information Section, there is a comprehensive technical library. Information is abstracted and card-indexed, the index containing over 200,000 references (in January, 1953). An abstract journal, *Packaging Abstracts*, is produced monthly ; it covers all forms of packages and packaging materials, including glass jars, metal cans and drums, flexible materials, etc.

Advisory and Testing Service

The Advisory and Testing Services are designed to give assistance on day-to-day packaging problems. During the year, between 600 and 700 inquiries are dealt with ; these may range from where to buy packaging materials or machines, through advice as to the best methods of packaging, to extensive laboratory tests leading up to the production of a prototype for a new package. These Advisory and Testing Services are available to non-members on a fee basis.

Two laboratories are devoted to this work, one for mechanical testing and the other for chemical and physical tests. In the former, packages can be tested in rotating drums or on a vibration table, by dropping, by crushing, or by an inclined plane impact tester. The purpose of these tests is to reproduce in the laboratory the hazards of transportation. In the other laboratory, physical tests such as the measurement of water vapour permeability of packages, oxygen permeability, etc. can be carried out and the 'shelf-life' of packages determined. Rooms with controlled tropical atmospheres, both hot and damp and hot and dry, and rooms with temperate controlled atmospheres are available for climatic storage tests. Refrigerated cabinets are used for storage at low temperatures (down to −20°C.). Problems of mould and insect attack on packages are dealt with in other laboratories devoted to mycology and entomology. Equipment is available for the construction of prototype packages and various methods of sealing, wire binding, and steel strapping.

Research

The programme of research is concerned with some of the fundamental and general problems of packaging. This programme is drawn up partly on the advice of a Packaging Advisory Panel, which provides a considerable body of practical knowledge on packaging, and partly on the advice of the staff of the Association, which is influenced by the day-to-day problems handled by the Advisory and Testing Section.

The main item on the research programme aims at providing the basic information which will enable packages to be designed on a scientific basis. This means that the effects which transport hazards, design of the package and materials from which it is made, etc., have on the protective qualities of the package must be established. The first step is to assess the hazards of transport. These are believed to be of three main kinds—drops or jolts, compression due to stacking, and vibration. Attention has been directed to the measurement of drops and jolts, and for this purpose the PATRA Journey Shock Recorder has been developed ; it measures the number of drops of a predetermined height, or over, which a package receives in transit. Using this instrument, a number of selected journeys are being studied, and the effect of method of travel (full container, mixed goods, passenger, etc.) is being investigated. Work is also done on the measurement of the cushioning properties of various packaging materials.

To determine and improve the protection against water vapour, methods have been developed for measuring the permeability of packaging materials and packages to water vapour. These methods are now being used to study the various combinations of packaging materials when made up into a package, and to investigate the effect of storing unit packs in an outer container on the 'shelf-life' of the contents. Determination of moisture vapour permeability of highly resistant foils at the low temperatures encountered in the quick-freezing of foods has also called for new methods, and instruments for the accurate control of relative humidity in rooms and cabinets used for climatic storage trials have been tested.

Some packaged goods are affected by light, and a knowledge of the wave-lengths of light which various wrapping materials transmit will enable the most suitable materials to be chosen. The transmission spectra of a wide range of transparent wrapping materials are being compiled.

The question of odour protection is also important ; the problem of devising a simple, semi-quantitative method of measuring the resistance of packages and packing materials to odours of various kinds is being investigated.

Work on the prevention of mould and insect attack on packages is directed to the development of a quantitative method for the estimation of mould infection of packaging materials, so that the degree of mould infection commonly experienced can be assessed. Major endeavour is also directed to the examination of the efficiency and suitability of fungicides and insecticides for use with packaging materials, with reference to the contents of the package.

Publications

Results of research are conveyed to members through the Association's Research Reports, Technical Papers, Bulletins, and Information Leaflets. In addition, a monthly news sheet, PATRA News, gives a popular account of the activities of the Association.

LIST OF RESEARCH WORKERS MENTIONED

Adam, W. B., 19
Anderson, A. I., *Chairman*, R.C.R.C., 41
Axford, D. W. E., 27

Banfield, F. H., 12
Banks, A., 4
Banks, W. H., 47
Barnell, H. R., 17, 19
Bartlett, S., 30
Bate-Smith, E. C., 2
Bell, Sir F. A., *Chairman*, H.I.B., 35
Bendall, J. R., 2
Bentley, E. W., 44
Blackburn, P. S., 33
Blaxter, K. L., 33
Brooks, J., 2
Brown, W. B., 42
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Campbell, J. D., 24
Cann, F. R., 44
Chapman, H. R., 30
Claridge, P. R. P., 2
Coppock, J. B. M., 27
Cosgrove, D. J., 24
Cox, C. P., 30
Cutting, C. L., 4, 8

Daniels, D. G. H., 24
Devlin, J. J., 27
Dickinson, D., 19

Engledow, Professor Sir F. L., *Chairman*, F.I.B., 1
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Holmes, N. E., 17
Holmes, W., 33
Hornby, C. D., 44
Hulme, A. C., 9
Hutchinson, J. B., 24

Ingram, M., 2
Isherwood, F. A., 2

Jones, C. R., 24
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Kent, N. L., 24
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Lawrence, M. D. A., 44
Lea, C. H., 2
Lovern, J. A., 4

Macdougall, G., 47
Mapson, L. W., 2
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Melrose, W. K., 17
Moran, T., 24

Owen, E. C., 33
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Pace, J., 24
Parkin, E. A., 42
Partridge, S. M., 2
Peers, F. G., 24
Pollard, A., 21

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Ridyard, H. N., 24
Rolfe, E. J., 19
Rowland, S. J., 30

Scott Blair, G. W., 30
Sharp, J. G., 2
Shaw, B., 24
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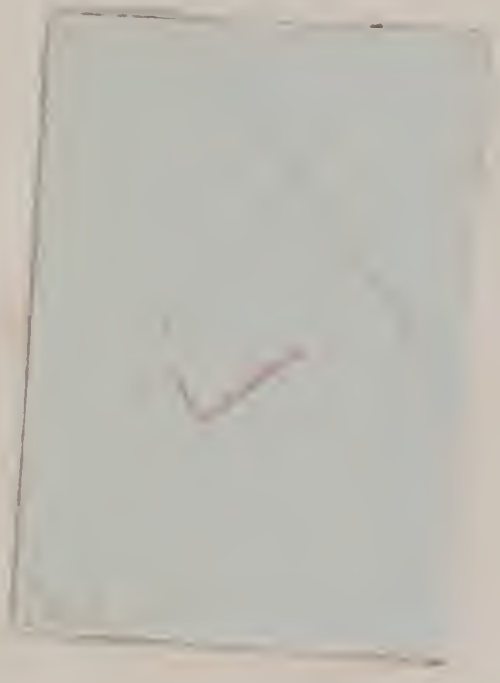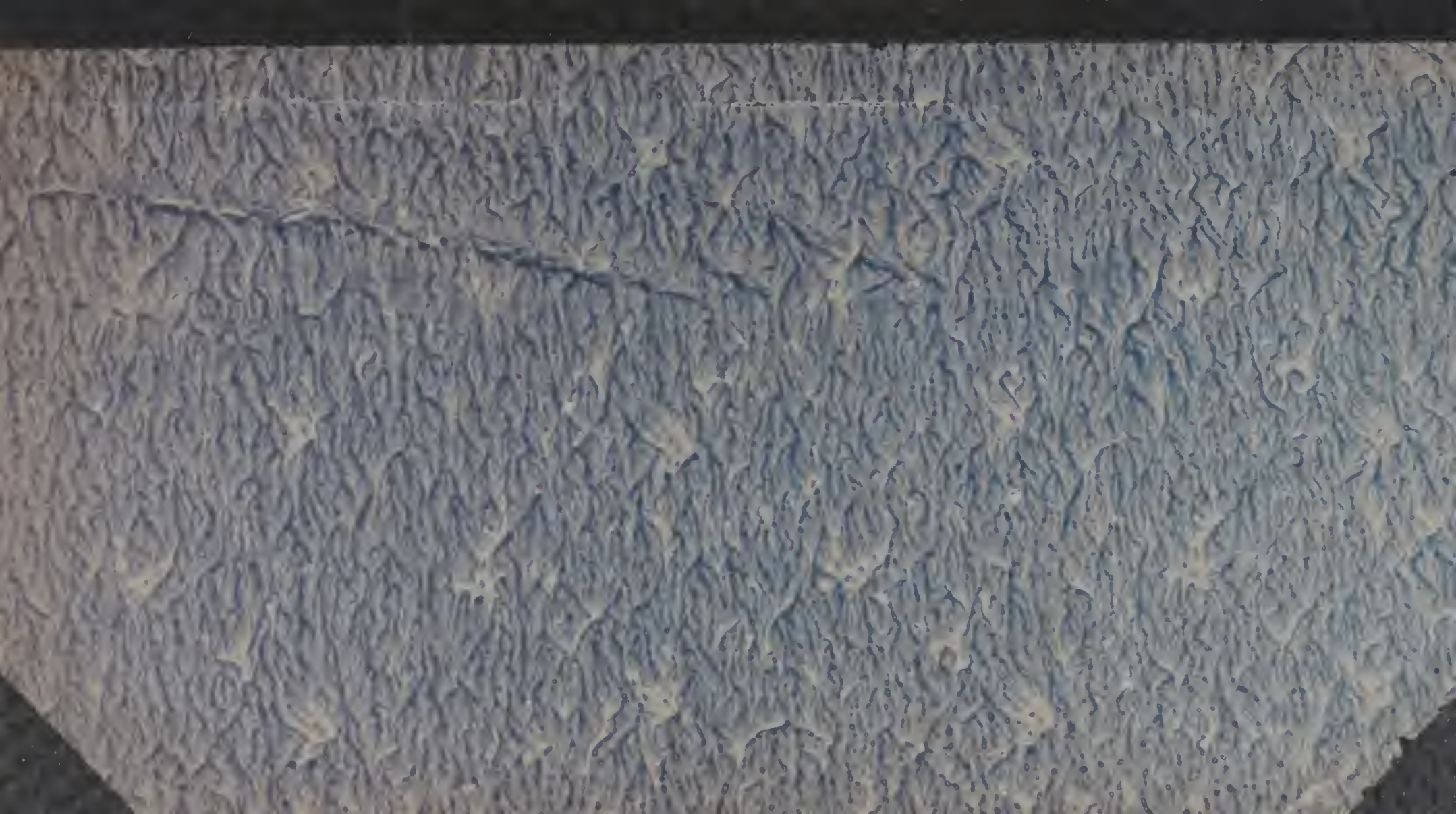
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